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| WM. TELL | |
| J. GRENNAN | |
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# ling Engineer

U. S. Pat. Office

me 20 — May, 1935 — Number 5

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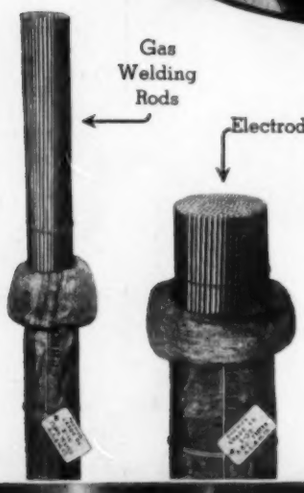
neer Business and Technical Journal of the Welding Industry

# GET MAD

## *if you must*

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# THE WELDING ENGINEER

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Published on the 15th of each month by The Welding Engineer Publishing Company, 608 S. Dearborn St., Chicago, Ill. Telephone Webster 7134.

**G. H. Mackenzie**, *President and Treasurer* — **F. L. Spangler**, *Editor* — **L. C. Monroe**, *Advertising Manager*

REPRESENTATIVES

EASTERN: T. E. Depew, American Circle Bldg., New York, N. Y. Tel. Columbus 5-7843.
PACIFIC COAST: W. R. McIntyre, 1115 Tyler St., Glendale, Calif.

Subscription, payable in advance: United States and possessions, $3 a year; Foreign Countries, $4 a year; Canada, $4 a year; Single copy, domestic, 25 cents; Single copy, foreign, 35 cents. Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

FOREIGN REPRESENTATIVES: GREAT BRITAIN—Capt. D. Richardson, 26 Winterbrook Road, Herne Hill, London; AUSTRALIA and NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand; SOUTH AFRICA—J. W. Arnison, 35a Victoria Avenue, Benoni, Transvaal, South Africa.

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# · E D I T O R I A L ·

## Know Your Base Metal, When Welding Steel

Every detail of the process of steel-making and every ingredient entering the furnace or ladle, are assuming greater and greater importance in this day when the welder must be able to fuse the rolled metal and obtain dense, ductile welds that will develop high strength and ductility and resist ordinary corrosion. When rivets and bolts were the only processes of fabrication, steel was generally accepted as steel, regardless of whether it came from an open-hearth or Bessemer furnace, or whether the carbon or sulphur varied by a few points, or whether aluminum was present in measurable amounts. Later a demand arose for closer tolerances in the ingredients, with the result that the steel-maker gave more attention to controlling the amount of the various elements going into the product. Also, the various processes entering the production of steel had to be given due consideration, since these have an important bearing on the chemical reactions going on in the steel bath and therefore are a factor in determining just what elements are partly lost from the bath and the extent of such losses. When adding deoxidizers to the steel, it was not sufficient just to "kill" it. The analysis of the final product had to be carefully noted, since weldability had now been added to high strength and ductility as an important requirement. ¶ The steel-maker finds it very easy and convenient at times to allow a few points of aluminum to remain in the metal after the deoxidizing process. If the evil effects of the aluminum on welding is not counteracted by the addition of other elements, the welds made on this metal will be porous, regardless of the amount of care or skill exercised in making the weld. One large fabricator who has had some steel of this kind in his shipments received from the mill, finds it impossible to use it on welded constructions. At last he has eliminated this difficulty by stating in all his steel specifications that the metal must be weldable. Not all fabricators have yet experienced such difficulties. A large manufacturer of tanks and other structures states that his company has had no trouble with any A. S. T. M. A-5 steel ordered from the mills, and they use a great amount of welding. Nevertheless, this suggests that it would be well for fabricators and erectors to specify weldability as a requirement when ordering from the mill, and then they will insure themselves against accepting material that does not make good welds, even though it might be suitable for riveted work. Fabricators who specify weldable steel are paying no greater base price than those who do not specify weldability as a requirement, it is reported, though it is probable that the making of weldable steel demands closer attention on the part of the steel-maker to the heating and killing of the bath, with a consequent smaller margin of profit. ¶ It would not be amiss to mention that unkilled, or rimmed, steel is finding favor for various uses because of certain peculiar properties imparted to the rolled product made from the rimmed ingot. Particular difficulty is apt to be encountered in welding some of the rimmed steels because the structure of the "rim" is quite different from that of the ingot core, and hence plates and sheets made from the ingot, and then sheared, would not present a uniform type of structure all along the sheared edge. With the manual arc, the welding operator probably could compensate for this variation by changing the heat or arc length as he welded along the edge, but difficulty would be expected with the automatic arc. ¶ Aside from the analysis and structure of the base metal, the strains set up by rolling, especially when the metal is passed through the rolls cold, should receive particular consideration, because it is apt to result in evil effects after fabrication—difficulties that might be blamed on the welding process itself. An illustration of this is a certain plate job employing one of the new high-strength steels. The plates were welded, and shortly thereafter they failed before an opportunity was had to put the equipment into service. The cracks, it was plain, started in the plate material at some distance from any of the welds, and followed across the welds into the adjoining plates. The only plausible explanation seems to be that the plates were cold when going through the last pass of the rolls, and incipient cracks developed which were made to spread by the stresses put into the plate by welding. It would have been easy in this case to place the blame on welded construction without making any attempt to determine whether the plate material itself was at fault. ¶ Every welder and fabricator should know his base metal. Only then can the highest efficiency and quality in welding be obtained.

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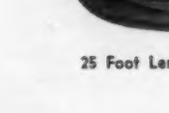

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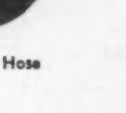

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# The Welding Engineer

VOLUME 20 MAY, 1935 NUMBER 5


## Miscellaneous Uses of the
# Oxyacetylene Torch on Track Work

■ By CHAS. WISE

LARGE savings are being made by the use of oxyacetylene outfits in welding worn frogs and switch points. However, there are many more uses to which a welding outfit can be put, also in more efficient ways than is the practice at present. To indicate some of these uses is the purpose of this article.

A very large saving can be made by reclaiming broken frogs. New frog points and wing rails can be made by the use of the cutting torch and an ordinary rail bender. Usually these can be made from odd pieces of fairly good rail—rail which is too short for use in track. It is also well to save any good parts from frogs which must be scrapped. In this way it will often happen that all that is necessary is to take the frog apart and put in one of the rails already at hand.

About the hardest thing in renewing parts in broken frogs is to take the frog apart. Usually most of the bolts are frozen in the filler castings. I cut off the bolts on both sides of the frog and take off the wing rails, then I melt the bolts out of the casting by using the oxygen lance, which is simply an air valve with an oxygen hose connection welded on one end and a piece of ¼-in. pipe with a coupling on the other end. The pipe we use is cut into 3-ft. lengths. As each piece is burned away, another piece can be screwed into the coupling. This method makes short work of taking any frog apart and the cost is surprisingly low.

Cutting Bolts on a Rail-Laying Job.

### Making a Point or Wing Rail

In making a point or wing rail, it is only necessary to cut off a piece of rail the same length as the part which is to be duplicated. If a point is being made, the next step is to find the place where it is to be bent. This can be done by laying a straight edge on the web of the old part. This is then measured off on the new rail, the rail is then heated at this spot on both sides of the web on the base, the bender is applied and the rail is bent to the angle of the broken point. The point is then marked off and cut out along the ball and base of the rail so that the shape is the same as the old point. One of the filler blocks of the frog is laid on the web of the point, and the holes marked with a punch through the holes of the filler block. All of the cutting is done with the blow torch except the bolt holes, which are drilled on a drill press. This whole operation takes only about an hour and a half. When the point is back in the frog, the worn parts of the wing rails are welded and the point given the final shaping with the aid of the welding torch. The scrap frog is as good as new and the cost of renewing the broken part is usually around $6.

The Frog Should Be Properly Clamped Down While Welding.

In open-hearth frogs, where the point is made in two parts, it is impossible to make the short point in the way described above. This is because the base is machined out to fit on the base of the main point. However, where these short points are broken, they can be successfully repaired by butt welding.

Where the rails on a frog are bent and not broken, they can be straightened. Where bent outward, a long bolt is inserted through the holes of both rails. The base of the bent rail is heated and

drawn back by tightening up on the nut. When straightening a rail in this manner, it should be bent a little farther than is apparently necessary, since the rail will have a tendency to bend outward slightly as it cools. Where the rails are bent inward, a small but powerful screw jack is placed between the rails to force them apart after they have been heated on the base. During the past three years I have reclaimed 103 frogs in some one of the ways just described and not one of them has failed.

Switch points for yard use may also be straightened by heating the base and using the rail bender.

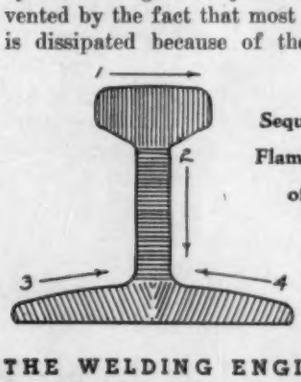
### Saving in Upkeep Effected by Butt Welding Rails

The butt welding of rail at terminals, station platforms, and highway crossings, is saving the railroads considerable money which formerly went for the upkeep of the joints at these places. However, not many roads are as yet butt welding rails on bridges. This practice could receive wider application, as it would result in a reduction in the cost of upkeep on the bridges. I believe it would pay the railroads to start experiments in butt welding long stretches of main-line track with the oxyacetylene torch. The saving on the upkeep of this kind of track would be very large. Butt welds can be made in this manner for $5 or less and can be made under traffic.

### Precautions in Building Up Rail Ends

A common mistake, in building up rail ends by welding, is to renew or reverse the angle bars after the rail ends have been built up, rather than before. Likewise, where the joint is too low it should be tamped up before welding. Where new angle bars are applied or the joints are tamped up after building up the ends, it will be found that the rail ends are too high. The reason for this is that when the bars are replaced, the new bars raise the rail ends slightly in addition to the amount they were raised by welding. In such a case, less welding would have been required if the bars had been renewed first, thereby reducing the cost per joint.

There is little likelihood that modern, heavy heat-treated angle bars will be affected adversely by the heat produced by the welding of the joint. This is prevented by the fact that most of the heat is dissipated because of the relatively large radiating surface of the rail and bar.




Sequence for Flame Cutting of Rail.

One of the newest developments in the building up of rail ends by welding is the introduction of the rail grinder. Grinders are especially useful on welds that measure more than 4 in. in length. It is rather difficult to get a smooth surface on a long weld with the flatter, as such welds must be applied in several patches. However, it is a comparatively simple matter to obtain a perfect surface with a grinder. The use of the grinder has increased the output of the welding gang, resulting in cheaper and better joints.

A recent development which is rapidly coming to the front is the use of the welding torch for heat-treating rail ends. In the case of new-laid rails, by heat-treating the ends shortly after the rail is laid it probably will not be necessary to build up the ends during the life of the rail. This same treatment can be given to the points and wing rails of frogs.

### Cutting Rails With Speed and Safety

The use of the oxyacetylene cutting torch can effect a large saving in the cost of cutting rails where a welding outfit is at hand, especially in these days when rails are used as long as it is possible to obtain a usable piece from them. One of the advantages of the use of the cutting torch is that rails can be cut without the necessity of removing them from the track. Another is that the cut can be made close to the end of the rail, which is not always possible by any other method. This is the safest way to cut rail, for there is then no danger of personal injury from flying steel. It takes only about 65 seconds to cut a 100-lb. rail, which is faster than by any other method.

Some maintenance-of-way men contend that cutting the rail with a torch will cause the rail to break. I have cut thousands of rails, including high-carbon-steel rails, by this method and have yet to have one of them break where the failure could be traced even remotely to the method of cutting. Of course, the proper procedure must be used.

There is only one safe way to cut a rail with the torch. Start the cut on one side of the ball, going straight across to the other side, then down the web, and last the base, starting on one side of the base cutting toward the center, then starting from the other side and cutting toward the center, as the accompanying sketch shows. In this way even the new high-carbon rails can be cut safely.

There are many other uses to which the welding torch can be put in the maintenance-of-way department, such as sharpening picks, straightening bent switch rods, repairing broken track jacks, making gauge plates or welding the old broken gauge rods, and many other small repairs.

During the past year or two there has been a tendency to obtain too much speed in welding, particularly in the building up of joints. I have seen hundreds of joints that have failed because the welder tried to put the metal on too fast. Others have failed because a new man on the grinding machine was required to do the work faster than the machine was capable of properly doing it. Such work of course tends to discourage other railroads from using the welding process,

Butt Welding a Rail in a Street Crossing.

when it is not the fault of the process at all. There is such a large saving to be gained by the proper use of this process that it is better to obtain a high quality of work at slightly higher cost, than to spend less and obtain work that will not stand up.

Some thought should be given to the most economical way in which frogs and switch points can be welded. For instance, in busy yards it may be cheaper by far to take the frogs out of the track for welding; also the switch points. The welding could be done in a building centrally located. Here the welder could work regardless of weather conditions. If possible, an acetylene generator might be installed to reduce the cost of gas.

It is good practice to plan welding operations in advance, thereby saving much time which otherwise would be lost in unnecessarily moving from one place to another.

### Supervision of Track Welding

Track welding is getting to be one of the most important operations on the railroads in the matter of money saved. Large sums are being spent each year on this process. Therefore more thought should be given as to the way in which this very important department will be supervised. A man of wide, practical track-welding experience should have charge. Some of the large manufacturers of welding equipment furnish service men to the railroads who also supervise the welders. It is my opinion, however, that these men cannot give the same service such as the road's own supervisor would be able to give.

Some roads leave the supervision of track welding up to the roadmasters or

the maintenance-of-way engineering department. After all, these men cannot get a real knowledge of track welding and all that goes with it, unless they have actually done the work for several years. In fact, it is very much the same as giving a man a course in a correspondence school in some business and then telling him to run it.

The railroads have their own man at the head of each of the various other departments. Then why not the track-welding department? When a railroad will spend $150,000 or more per year on track welding, then it is time they had their own track-welding supervisor, who would work in conjunction with the service man furnished by the welding-equipment manufacturer. In this way better results would be had all around.

## Inaugurates Novel Campaign on Hard-Facing of Teeth

Sharks' teeth form the central theme of an effort to sell the advantages of hard-facing to quarries, highway contractors, and others, the campaign being the idea of J. D. Tierney, of the Storts Welding Co., 42 Stone St., Meriden, Conn. A small shark's tooth, made into a charm suitable for watch chain or fob, a post card carrying an actual photograph of a disemboweled shark, and a letter in colors, ornamented with the word "Teeth" at the top in large letters, with a harpoon above and below the letters, and an illustration in colors at the bottom showing the harpooning of sharks from a boat, with one man in the act of throwing the weapon at one of the monsters—all form a part of the drive to create interest in hard-facing teeth. The letter reads as follows:

"Dear Sir:

"The power of a shark is small compared to the power of quarry and road-building shovels.

"Some sharks have little teeth. Others have larger teeth. This is also true of shovels. Both, however, to a great degree are dependent on sharp teeth for the 'bite' that makes the respective work of each fast and sure. Dull teeth are always a handicap.

"Nature keeps the shark's teeth sharp, as you will find after examining the shark tooth enclosed. It is a specimen tooth of many small teeth which the shark uses in attacking his prey.

"With these small teeth, this dangerous enemy of man can pull a man's arm out of its socket with one 'bite' and a twist, as can be noted in the enclosed photo-reproduction.

"While shovel teeth are not man's enemy, to pull a man's arm out of its socket, dull shovel teeth without the right 'bite' do pull a lot of money right out of man's pocket, unless man keeps his shovel teeth sharp.

"The right way to keep shovel teeth sharp and avoid losses is to let us retip strong, sharp points to your dull teeth in the Storts way—the way that will keep those lost dollars right in your pocket.

"You will always find us ready at the other end of the telephone wire to have our welding service help you, when you call 1991."

This mailing, including tooth charm and photograph, was sent to a list of 80 quarry owners and road builders as a means of increasing teeth-retipping business. Referring to the photograph of the shark, which plainly shows a human hand and arm as part of the stomach contents, Mr. Tierney says:

"While the photo-reproduction is, at first impression, rather depressing, we have found in studying the reactions of the recipient that about the first thing he does and continues to do is to show it and the shark tooth to all within his reach, which after all is just the right reaction we look and hope for—that word-of-mouth publicity. So, we find depressing pictures of value to depression eras—in a special rather than general way, however."

## J. J. Crowe Is New Head of American Welding Society

New officers of the American Welding Society, announced at the annual meeting held in New York City on April 25th, are: president, J. J. Crowe, of the Air Reduction Co., New York City; senior vice-president, Edwards R. Fish, chief engineer, Boiler Division, Hartford Steam Boiler Inspection & Insurance Co., Hartford, Conn.; and the following new divisional vice-presidents: Pacific Coast Section, Turner C. Smith, of the General Petroleum Corp. of California, Los Angeles; and Southern Section, E. E. Gillman, of the Wyatt Metal & Boiler Co., Dallas, Tex. New directors-at-large are: C. A. Adams, of the Harvard Engineering School, Cambridge, Mass.; H. M. Hobart, of the General Electric Co., Schenectady, N. Y.; F. T. Llewellyn, of the United States Steel Corp., New York City; G. D. Spackman, of Lukenweld, Inc., Coatesville, Pa.; and H. L. Whitney, of The M. W. Kellogg Co., New York City. Both C. A. McCune and Miss M. M. Kelly were re-elected treasurer and secretary, respectively, of the Society.

John J. Crowe, Who Has Been Elected A. W. S. President.

The new president, John J. Crowe, is Engineer in Charge of Apparatus Research and Development for the Air Reduction Co., which position he has held since 1924. He has taken out a number of patents applying to oxyacetylene equipment and is the author of some noteworthy papers pertaining to the use of oxygen and oxyacetylene equipment. Years ago, when with the U. S. Bureau of Standards, he was co-author of several papers on thermometry, pyrometry and metallurgy.

He has held the chair of director of the metallurgical department at Temple University, in Philadelphia, and has also been associated with the U. S. Navy as physical metallurgist. While at the Philadelphia Navy Yard, he effected great savings in the cost of producing large forgings, by applying the oxygen-cutting process, and also promoted the use of fusion welding in the forge shop and the foundry. To him belongs the credit of establishing the first metallurgical laboratory in any of the navy yards, this being at the Boston yard. He later established similar laboratories at the yards in Philadelphia, New York and Norfolk.

Mr. Crowe's active work in metallurgy dates back to the time he started as an apprentice at the Bureau of Standards, immediately after his graduation from high school. While associated with the Bureau, he attended George Washington University.

He served as director for ten years of the American Welding Society, and has taken an active interest in the American Society for Metals, Compressed Gas Manufacturers Association, International Acetylene Association, American Society for Testing Materials, and American Institute of Mining & Metallurgical Engineers.

## Builds Welded Equipment in Open-Air Factory

Nine welding machines, a drill, a lathe and hacksaw, an acetylene-gas plant and an air compressor are used in the world's largest open-air factory for the manufacture of heavy road-grading equipment. Production has been progressing rapidly in the Peoria, Ill., "open air" factory of R. G. Le Tourneau, Inc., of Stockton, Calif., who recently chose Peoria as the site for manufacturing their products. A force of 30 men are working in two shifts. With the completion of the buildings, the company will move its equipment inside, and eventually will employ approximately 125 men. The $50,000 factory unit under construction is 300 ft. long, and present plans call for another structure of similar size.

Le Tourneau scraper No. 1, the first machine to be built in Peoria, is made entirely of alloy steel and will have a capacity of 8½ tons. It will be the biggest scraper of its kind ever built, it is claimed, and will be able to remove 12 yards of earth in 1½ minutes. It is to be drawn by a Caterpillar Diesel 75, and rolls on six balloon tires.

**General View of Grand Coulee Dam Project, Looking From the East Side of the Columbia River.**

(At the left center is visible the beginning of the steel cofferdam, and beyond is the mile-long belt conveyor, with a capacity of 4000 tons of dirt an hour. In the left foreground is the steel-constructed maintenance shop, the low extension at the left of this being the welding shop, and in front of that the welding yard.)

# Welding Under Difficulties . . . at Coulee Dam

By HENRY W. YOUNG

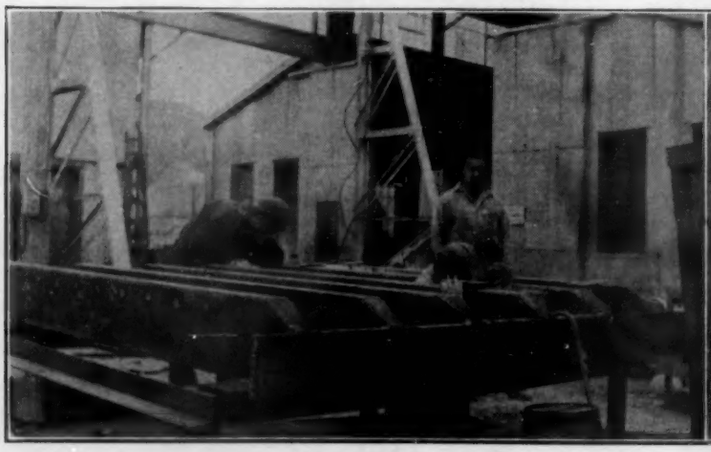
WELDING operators at Grand Coulee dam must not only be skillful and expert with the arc and cutting torch, but must adjust themselves to unusual situations quickly so there is no lost time. The contractors expect the operators to maintain a fairly fast rate of speed, whether working on the ground or suspended down on the side of the cofferdam, and they are put through a rigorous physical ordeal before starting. Hence, few of those who apply for work are accepted after a day's tryout.

One such welder, whose experience would ordinarily qualify him for any field welding job, and who one time had a shop of his own, came down from Seattle to work. The first thing he was required to do was to walk rapidly up a nearby hill and back, after which examiners noted his blood pressure, heart action and respiration.

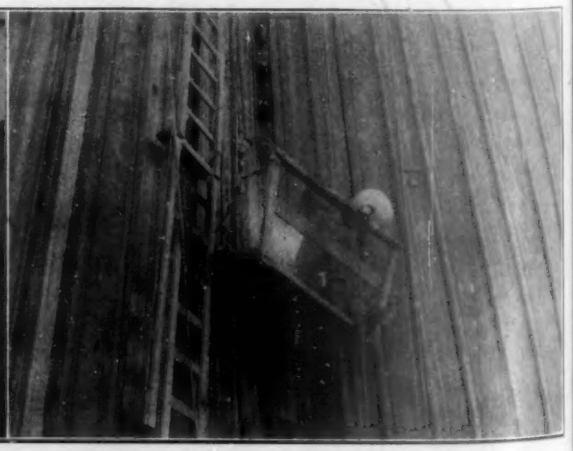
Being found sound of wind and limb, he was told to go down to the cofferdam and start in.

The outer wall of the cofferdam consists of 80-ft. lengths of interlocking steel piling, driven by steam hammers to bed rock or refusal. Being very thin in proportion to the length, buckling of the wall during driving was not at all uncommon. The procedure then was to let a man down in a sling, where, poised in the middle of a 60-ft. drop, he would cut out a section of several feet with his gas torch, then the top portion of the pile would be let down to abut on the lower end, after which he would weld the two together with the arc, current being supplied from a portable welding set.

The Seattle welder was slung over the side to cut and weld a pile, this being the first job given him. He proceeded to do the work, and then cut and welded several other piles. He thought he was getting along pretty well, considering that this was his first day at it. On the next morning he was informed that although his work was satisfactory, he



**Welding Up a Grizzly From 12-In. Steel Channels. All Wearing Surfaces Are Hardened.**



**Welding Rivet Holes in Cofferdam While Suspended From Above. Lights Are Provided for Night Work.**

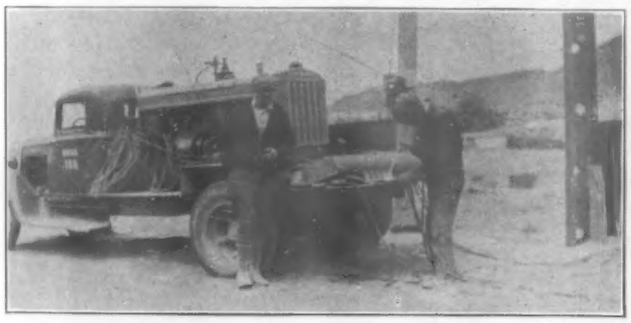
couldn't make the time, and therefore his services were not needed.

On his way back to Seattle he was picked up by a distributor of welding supplies in Spokane, who tells the above story.

If Grand Coulee dam is carried through to an irrigation project, as seems probable, and the "high dam" is built, it will represent the only structure ever built that exceeds in size the Great Pyramid of Egypt, so the report goes.

In building the present "low dam," which is to be used for power development only, all the excavation and other preliminary work is being done in a manner to permit of going on up to the high level whenever the word comes. This has necessitated the assemblage of a great amount of heavy equipment such as steam shovels, cranes, hoists, trucks, crawler-type dump wagons, etc., as well as the construction of a belt-conveyor system over a mile long, with a 60-in.-wide belt, which removes over-burden and earth from the excavation at the rate of 4,000 tons an hour and dumps it into a distant ravine.

Therefore, welding and cutting operations are going on constantly on a large scale. Aside from the work just mentioned in connection with pile driving, when the west-side cofferdam was completed, over half a mile long, all the ends of the steel piles were cut off even, over 90 cutting torches being used at one time in that phase of the work.



**Welding Outfits Have Benches on Rear, Where Ordinary Repairs Can Be Carried On. These Units Also Supply Current to Welders Working Down Side of Cofferdam.**

Later, when the steel structure of the cofferdam had been completed, the whole outer surface was gone over carefully, welders lowered on stagings closed up all rivet holes, welded the seams in three-way piling, and filled up any openings that would admit water. Current was supplied from welding machines on trucks which were located 30 to 50 ft. about them on the fill between the outer steel piling and the row of wood piling driven within.

Practically all the welding operations are performed with the arc. Gases are used principally for cutting operations. Among the prominent welding operations may be mentioned the reclaiming of gears and pinions; the building of large sprockets by welding a steel plate onto a hub and then machining out the teeth; hard-surfacing and pointing innumerable bucket teeth; the manufacture of giant grizzlies out of 12-in. channels, through which the dirt is "strained" before passing onto the belt; manufacture of bases for cranes and hoists; and repairs on machinery of all kinds, the field work being done with portable machines and some repairs being made in the welding shop, which is an adjunct to the maintenance machine shop, or in the open welding yard adjacent to the shops.

The amount of equipment used in this undertaking as of May 1, 1935, consisted of seven 300-ampere gasoline-engine-driven welders and five 300-ampere electric-motor-operated welders.

Three of the portable welders are kept out on the job for piling work and three for maintaining shovels. The rest of the welding machines are in the shop and adjacent yard. An average of about 1,000 lb. of welding rod is used per week. Welders and helpers on May 1st numbered 56. There is plenty of work for them to do. For instance, here is the line-up of trucking equipment alone that must be kept in repair: 16 trucks ranging from 4 to 11 cu. yd., 27 crawler-type wagons ranging from 7 to 16 cu. yd., 16 crawler-type tractors and 5 crawler-type bulldozers. Of steam shovels there are eight, with a dipper capacity ranging from 2 to 6 cu. yd.

The bulk of the 13,000,000 cu. yd. of excavation, together with the erection of the low dam to completion, is being done by the Mason-Walsh-Atkinson-Kier Co., who operate the above equipment. H. L. Myer is general manager; H. L. Slocum, superintendent, and C. D. Riddle, job engineer.

The project is being built by the U. S. Bureau of Reclamation, Department of the Interior. F. A. Banks is construction engineer in charge; J. H. Miner, office engineer, and A. F. Darland, field engineer.

## Corrosion-Resisting Steels Is Topic at Meeting

Applications of corrosion-resisting steels were considered by the two speakers at the meeting of the New York Section of the American Welding Society, held on May 14th. The following program was scheduled: "Corrosion-Resisting Steels in the Petroleum, Chemical and Allied Industries," by H. L. Whitney, chief engineer, The M. W. Kellogg Co.; "The Use of Stainless Steels in Architectural Work," by Edmund Peremi, vice-president, General Bronze Corp. Dr. W. M. Mitchell, metallurgical engineer, Illinois Steel Co., was on the program as presiding officer. New officers for the coming year were also to be installed.

## Philadelphia Section Elects New Officers

W. F. Carson, of Carson & Carson, is the new chairman of the Philadelphia Section of the American Welding Society. Other officers recently elected are: vice-chairman, C. I. MacGuffie, General Electric Co.; treasurer, R. D. Thomas, R. D. Thomas & Co.; secretary, H. E. Hopkins, R. D. Thomas & Co.; members of the Executive Committee to serve for three years, John J. Dunne, E. G. Hosted and Philip W. Snyder; and representative on the Board of Directors, R. D. Thomas.

## Outline of Welding Course at Oklahoma College

An elective course in welding is being offered students of the Oklahoma Agricultural and Mechanical College, at Stillwater, Okla., according to E. D. Soderstrom, associate professor, engineering shop. This course, designated as Shop 362, is open to those students who have taken the prerequisite course, Shop 241 (forging and heat-treating).

The Shop 362 course consists of 16 lecture periods, constituting one hour each week, and, in addition, three hours per week for 16 weeks is devoted to shop practice with oxyacetylene and arc-welding equipment. The main topics in the course outline are:

Welding in Industry: Oxyacetylene; electric (arc and resistance); atomic hydrogen; thermit; oxy-hydrogen; natural and city gas.

Discussion on Blowpipe Design: Types of blowpipes or torches (low- and high-pressure and multiple-tip); combustion process in torch; type of flame; speed of flame propagation; starting and stopping.

Metallurgical Factors in Steel Welding: Metallurgy of steel; impurities and defects in welds; fluxes.

Physics of Liquids Relating to Welding: Cohesion, capillarity, surface tension, fluidity, viscosity; depositing metal (down-hand, on vertical surface, overhead, filling hole, melting down boss).

Flame Cutting: Combustion of iron; calculations.

Metallurgy of Cast Iron: Composition of gray cast iron; rate of cooling; effect of silicon; repairing by brazing.

Malleable Cast Iron: As cast; malleableized; effect of fusion; brazing.

Fundamentals of Welding Analysis: Classification of materials; chemical conditions; structural conditions (heat-treatment, forging and working, hammering and peening); properties expected of weld; technique of welding; direction.

Testing of Welds (mild-steel specimens): Preparation; welding; heat-treatment; testing; structural and physical results.

Stress in Welds: Due to function of part; due to welding heat.

The Electric Arc: Characteristics; polarity.

Comparative Costs (gas welding, arc welding, riveting).

Hard-Surfacing: Desirable characteristics; materials; uses.

# Magnetic Flare and Arc Blow in Welding—I

*(First of Two Articles)*

From a paper read before the Cleveland Section, American Welding Society, on March 19, 1935.

■ By ROBERT NOTVEST
Welding Engineer, J. D. Adams Co.

THE metallic or carbon arc is a tool through which fusion metal is created. On the face of it, the metallic arc appears extremely simple—an electric flame between a wire held in a suitable holder and the work which is to be fabricated through fusion welding. If

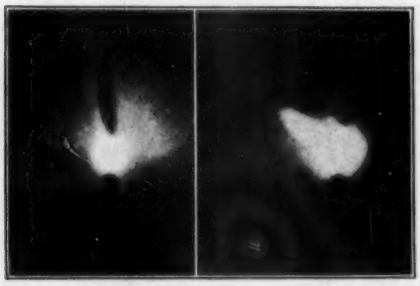


**Fig. 1. The Carbon Arc (at Left) Is Distorted (at Right) by an Exterior Magnetic Field.**

(Arc formed between two $\frac{1}{4}$-in. diameter graphite carbons. Arc potential, 48 volts, with about 90 amperes flowing. In the right-hand view, the very pronounced flare toward the left is produced by placing a U-shaped magnet from a 6-in. voltmeter close to the arc.)

the complicated physical and chemical phenomena which take place in a welding arc are properly adjusted or compensated for, then strong, ductile, dense fusion metal is produced with minimum injury to the parent metal; if this is not the case, porous, brittle, low-strength fusion metal is formed with a heat injury to the parent metal which may reduce its physical properties to less than half their original values.

Every welding operator is well acquainted with the occasional wild flaring of the d.c. arc which, under certain circumstances, makes it almost impossible to weld. Such a condition may be caused by a turbulence of heated gases within or near the arc zone or by the action of magnetic fields, either external or set up by the welding arc itself. It behooves us, therefore, to differentiate very sharply between disturbances set up by magnetic conditions (magnetic flare), and arc blow, which is caused by the turbulence of heated gases emanating either from the coating or the fusion metal.

## Steel Becomes Non-Magnetic Above Critical Temperature

Since probably over 95% of the arc welding done today still deals with low- or medium-carbon steel, we are of course vitally interested in how the welding heat might affect the magnetic properties of this material. In the well-known iron-carbon equilibrium diagram the demarkation line $A_2$, at about 760° C., indicates the critical temperature range above which steel or iron is non-magnetic, but when falling below such a temperature value very suddenly becomes strongly magnetic.

Since we will have to arc weld in the very near future low-alloy-content, high-physical-property steels, it might not be amiss to call attention to the fact that certain alloying ingredients of steel, such as cobalt and chromium, will raise the de-magnetization temperature, while others, like nickel and copper, will slightly lower it. In any event, when considering troublesome magnetic flare in arc-welding operations, we must realize that not only the heated end of the electrode and the pool of molten metal on the work, but also large areas adjacent to the fusion zone proper, may have reached a temperature above the magnetic transformation point (around 760° C. or 1400° F.) and, therefore, will constitute a barrier, a magnetic void, to the distribution of the magnetic flux lines set up by the arc current.

An electric arc represents the passage or flow of current across an air gap, which normally is a non-conductor of electricity. The arc stream is a gaseous flexible conductor, and is distorted by magnetic fields the same as is any other kind of conductor.

Fig. 1 illustrates the effect of a low-intensity magnetic field on an arc. To show the magnitude of the distorting force, it can be calculated that for a conductor 1 cm. long carrying 100 amperes and exposed to a magnetic field of 10 gausses perpendicular to the direction of current flow, a distorting power of 0.01 gram is produced in a direction perpendicular to both the magnetic field and the conductor (see Fig. 2).

## Small Force May Produce Large Distortion

A diverting force of 10 milligrams does not appear very strong, but it will nevertheless cause quite a distortion in an arc simply because the arc stabilizing force is very much smaller. Quantitative measurements on actual welding arcs are extremely difficult to make on account of the inherent instability of

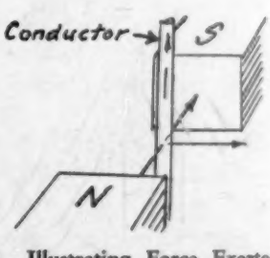



**Fig. 2. Illustrating Force Exerted on a Conductor by a Magnetic Field.**

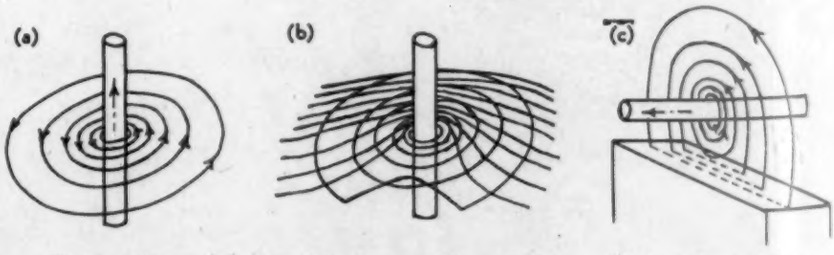



**Fig. 3. Effect of Certain Influences on Magnetic Lines of Force Surrounding a Conductor.**

**Fig. 4. Distortion of Carbon Arc by Presence of Iron Mass.**

(Edge of iron block is barely visible at the left of the arc.)

the arc and, of course, would be still more unreliable under shielded-arc conditions, where a certain amount of arc blow is caused by the high thermionic-emission effect of coating ingredients and the shielding gases developed through the burning of the coating itself.

The electromagnetic-field theory of Faraday assumes that whenever current flows through a conductor, magnetic lines of forces are produced in the form of circles concentric to the conductor. The density of these lines of force diminishes directly as the distance from the conductor, as shown in Fig 3 (a).

If the conductor, however, is situated in a foreign magnetic field of uniform density, then the parallel lines of force of the foreign field and the radial lines of force produced by the flow of current through the conductor interfere with each other and create a concentration of flux density as shown in Fig. 3(b). It is readily perceivable that the increased magnetic density on one side and the decreased magnetic density on the other side should produce sufficient distortion to influence a flexible gaseous conductor like the welding arc.

## Arc Flare Influenced by Foreign Magnetic Fields

However, in a good many instances in arc welding, the flare of the arc is not caused by distortion of the arc stream through a foreign magnetic field, but by the fact that the shape of the work diverts or absorbs to a large extent the circular lines of magnetic flux produced by the welding current. If a conductor is situated in close proximity to a large mass of iron, the normal space extension of the circular lines of forces will be distorted as approximately shown in Fig. 3(c). Now if instead of wire a welding arc were used, that is, a flexible gaseous conductor, the arc should be distorted and drawn towards the mass of iron. The direction in which the welding current flows has no influence upon the magnitude of this distortion, for if the direction of current shown in this sketch were reversed, the density of the magnetic field would be the same and only the turning direction of this slowly rotating field would be reversed. Fig. 4 shows the actual distortion of a small carbon arc caused by the proximity of a large mass of iron.

It is hardly possible to predetermine the direction of possible magnetic flare only through consideration of magnetic-flux density on a given piece of work. The reason is that, while the position and the direction of current flow in welding cable, electrode holder and electrode can be fairly accurately surmised and pictured in form of magnetic-flux densities, this, however, cannot be done with the erratic path in which the welding current flows back from the fusion zone through the work to the ground terminal of the return cable. Another difficulty is produced in this sense by the heating of the metal in the vicinity of the arc. As already pointed out, mild-carbon steel loses its magnetic qualities around 760° C. and, therefore, not only the actual fusion zone, but in instances of heavy-ampere welding, large areas of the work directly adjacent will become non-magnetic to a considerable degree.

Fig. 5 illustrates the distortion of a carbon arc and shows why the arc flares away from the side to which the ground or return connection is made.

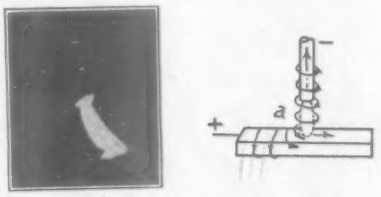



**Fig. 5. Illustrating Influence of Ground Connection on Arc Flare.**

(Low-ampere carbon arc burning perpendicular to the surface of a ½-in.-thick mild-steel plate. The ground or return connection is about 12 in. to the left of the arc. The arc is distorted and flares toward the right, which phenomenon is explained by the diagram, showing the rotating, concentric magnetic lines of flux surrounding the conductor. In the arc zone, this column of flux lines is bent, creating a concentration of flux density at *a*. On the work, the magnetic lines are almost completely absorbed into the mass of the metal, leaving on the right-hand side a magnetic void, into which the arc stream is readily distorted. The direction of repulsion of the arc is, therefore, directly opposite to the side on which the ground or return connection is made.)

The carbon arc was chosen in all these experiments and demonstrations since it burns smoothly at low currents and for a sufficient length of time to enable the taking of photographs without it being necessary to arrange for a constant-rate automatic feed.

The concentration of magnetic flux caused by the position of the ground or return connection can be made visible by using pulverized iron, as illustrated in Fig. 6, which also shows how to create a more uniform distribution of the flux.

## Controlling Arc Flare by Location of Return Connection

In a good many instances of nasty arc flare, a relocation or duplication of the ground or return connection will correct the trouble or reduce it to such an extent that it will no longer bother the skillful operator. The practical operator should be well acquainted with the fact that not only the ground connection but, more so, the position in which the electrode is held in relation with the work, will greatly influence the magnetic conditions surrounding the arc and, therefore, also its stability. These facts are brought out in Fig. 7.

By connecting the ground to the iron plate on opposite sides of the arc, as shown in sketch A, Fig. 7, the arc current creates two flux fields of approximately equal strength and, therefore, the arc burns smooth and perfectly perpendicular. Sketch C shows the theoretical magnetic-flux distribution if the electrode is held in a 45° position towards the right, in which case a flux concentration is created at *b* which is directly opposite to and practically neutralizes the concentration at *a*, and hence we obtain an extremely stable and smooth-burning arc.

Suppose we wish to create an arc condition where the arc flare forces

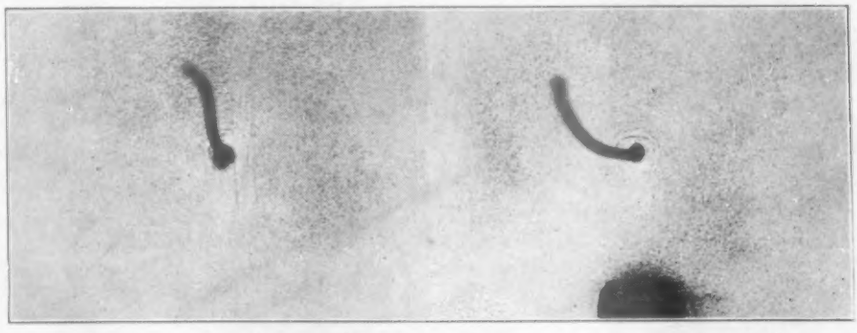


**Fig. 6. Views of Flux Distribution With a Single Ground and With Two Ground Connections.**

(A $\frac{1}{8}$-in.-diameter electrode was welded perpendicular to a plate, then the plate and the electrode were connected into a welding circuit. Pulverized iron, sprinkled upon a sheet of paper placed on the plate, oriented themselves into the patterns shown. In the left-hand pattern, it is evident that the ground or return connection is located in the lower left-hand corner of the photograph. In the right-hand pattern, a second ground connection was added in the upper right-hand corner, resulting in a more equal distribution of the flux lines.)

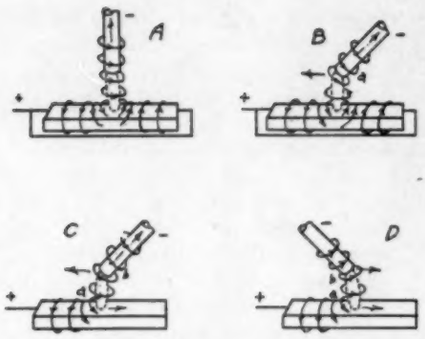



**Fig. 7. Illustrating the Effect of a Double Ground Connection and of Tilting the Electrode.**

the extremely liquid slag of shielded-arc welding to flow or be blown away from the pool of molten fusion metal. Sketch B, Fig. 7, shows that a double ground connection can eliminate arc flare towards the right, and all the distortional force is concentrated at *a*, which would force the arc flame towards the left.

If the operator now tilts the electrode, leaning towards the ground connection, as shown in sketch D, the arc flame will invariably blow ahead of the forming fusion bead. This is a very disadvantageous condition, for now magnetic flux concentration at both *a* and *b* exercise a distorting influence in the same direction and thereby create an extremely undesirable flare towards the right.

### Influence of Liquid Pool on Flux Distribution

So far we have not considered at all the influence of the pool of liquid metal upon the magnetic-flux distribution of the arc zone. Even if all other contributory influences are reduced to the minimum, such a manipulation as tilting the electrode towards the ground on straight butt welds has a tendency to cause the arc to flare back over the forming fusion bead. This is readily understood when considering that we not only have in the fusion zone a pool of liquid and, therefore, non-magnetic iron, but also a considerable area of the parent metal adjacent to the fusion zone has been heated up beyond 760° C. and, therefore, has lost its permeability for the magnetic flux. In other words, in arc welding we create at the pool of molten fusion metal and its immediate surroundings an area of non-magnetic material, which causes the normal lines of flux to be distorted and absorbed in the colder adjacent areas where the temperature is below 760° C.

In addition to this, especially on butt welds, as the arc is progressing, the magnetic lines of force have to bridge the air gap where the parent metal has not as yet been united through fusion. Here the lines of flux transmitted and concentrated by the metal are expelled into the air, whereas behind the arc within the slowly cooling fusion bead they cannot immediately be transmitted throughout the mass of the metal and have to find their path at a point where the temperature has fallen below 750° C. This constitutes two distorting influences acting in the same direction — namely, towards the forming fusion bead.

An experienced operator will readily recognize the situation described, which is particularly bad on the bottom of a butt weld on a fairly thick piece, say, a 1- to 1½-in. plate. Experience has shown that when the first small bead has connected both plates, materially less magnetic flare is encountered on subsequent layers.

### Controlling the Arc in Automatic Welding

In automatic arc welding, with either the metallic or carbon arc, magnetic flare can be substantially lessened by mounting the return circuit under the firing strip, or by superimposing a strong magnetic field upon the arc zone, through which, for example, it is possible to concentrate the flame of a carbon arc into a very small area and practically point it at any desired spot. This also stabilizes the arc, for obvious reasons, to an almost unbelievable degree. Fig 8 illustrates both these principles of arc control.

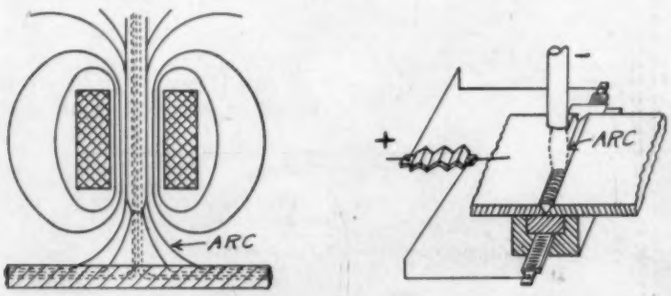



**Fig. 8. Two methods of Stabilizing the Automatic Arc.**

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*(The causes of arc blow, and its control, will be dealt with in the concluding article, to be published in the next issue of* THE WELDING ENGINEER.)

## Milwaukee Section Holds First Meeting

The first meeting of the Milwaukee Section of the American Welding Society was held on Thursday evening, April 18th, at the Milwaukee School of Engineering. The following officers were elected: Chairman, Otto Voss, of the Allis-Chalmers Manufacturing Co.; vice-chairman, K. L. Hansen, of the Harnischfeger Corp.; secretary-treasurer, J. J. Chyle, of the A. O. Smith Corp.

The speakers were R. F. Helmkamp, of the Air Reduction Sales Co., New York City, who gave an illustrated lecture on "Advances in Machine Construction by Gas Cutting and Welding"; J. R. Houston, of the Harnischefeger Corp., who also gave an illustrated lecture on "Qualifying Welding Operators"; and J. A. Stemper, of the United Air Lines, who exhibited a two-reel film, "Across the Continent in Eighteen Hours." The meeting was very well attended and plans were made to complete the organization of the Milwaukee Section and for future meetings.

## Pittsburgh District Reports Great Activity in Welding

Welding activities are increasing rapidly in the Pittsburgh district, according to well-informed steel leaders.

One of the largest recent inquiries is for a number of welded oil barges for the American Oil Co. The barges are to be 198 ft. long, 35 ft. wide, and 8 ft. deep and are to be used in the river trade. Other inquiries are said to be pending for oil tanks, water tanks and tubing. In addition, there is considerable repair work on craft for the river trade.

Practically all of the large steel companies are negotiating for welding business, including the McClintic-Marshall Corp., Jones & Laughlin Steel Corp., The Dravo Contracting Co., Treadwell Construction Co., Carnegie Steel Co., and American Bridge Co. The Republic Steel Corp. and the National Tube Co. are said to have many inquiries for welded pipe.

## Program Announced for Los Angeles Meeting

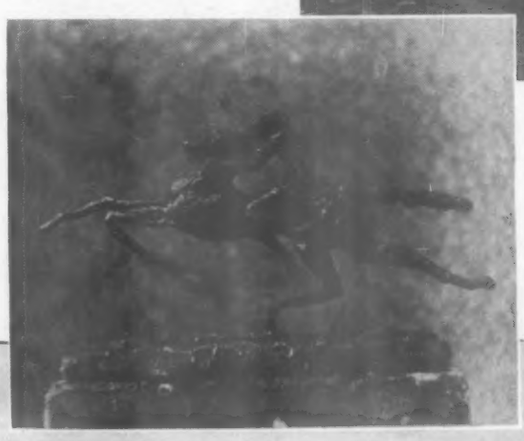
Two interesting features are included in the program of the Los Angeles Section of the American Welding Society scheduled for the evening of May 16th. A paper will be presented by J. M. Keir, of the Union Carbide & Carbon Research Laboratories, Inc., entitled "Research Activities of the American Bureau of Welding." This will be followed by a talk by Dr. Donald S. Clark, of the Metallurgical Department of the California Institute of Technology, of Pasadena, Calif., on "Metallurgical Properties of Fusion-Welded Joints."

# WELDING NEWS
# ▪ IN PICTURES ▪

• New steel-framed building erected on the grounds of the Spring Grove Hospital at Baltimore, Md. All members of the framework were welded with the electric arc, no riveting hammers being used. Electric welding saved seven tons of steel and reduced time of erection from weeks to days. (Photograph courtesy of The Lincoln Electric Co.)

• These welded tanks were made under the A. S. M. E. Code for Class 2 pressure vessels, and carry carbon dioxide under 400-lb. pressure. Built by the Ohio Machine & Boiler Co. for the Cleveland-Sandusky Brewing Co. (Information furnished by The Champion Rivet Co.)

• Instead of using clay to model with, Frank Aretz, of Pittsburgh, Pa., uses the oxy-acetylene torch and welding rods. If an artist who isn't a welder can make up a statue like this by puddling metal with the torch, let some of you who are welders try it.

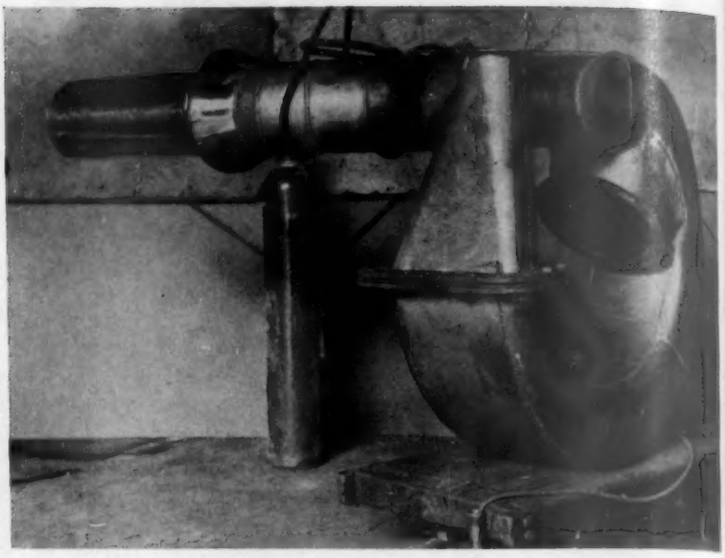


• This welder built by Merton Moon, of the Moon Machine Works, Bloomer, Wis., will handle any of the big field jobs. It has a 300-ampere generator hooked to a Packard Straight-8 motor with five V-belts.

• 10-ton all-welded crane, with 110-ft. span, built by The Cleveland Crane & Engineering Co. for the Great Lakes Steel Corp., Detroit, Mich.

# Arc Welding Monel Metal and Nickel

By F. G. FLOCKE and J. G. SCHOENER
Development & Research Department
The International Nickel Co., Inc.



**Intricate-Shaped Unit of Monel Metal, Entirely Arc Welded.**

(This unit was made of $\frac{1}{4}$-in. sheet, with the seams beveled from the inside to a total angle of about 70°. The first bead was laid on the inside with a $\frac{1}{16}$-in. or $\frac{5}{32}$-in. No. 30 monel electrode, then the outside of the seam was chipped and cleaned and a second weld laid on from the outside. The inner welds and also the exterior cylindrical section were ground and polished to a high mirror finish, obliterating all trace of the welds. Transverse bend tests made on welds in scrap metal indicated that the deposited metal was very ductile.)

MONEL metal and nickel are regularly welded by all the processes commonly used with steel, including metallic arc, carbon arc, oxyacetylene, and resistance welding methods. Arc-welding practice on these two materials is described below, while the oxyacetylene welding and silver soldering of nickel and monel metal were discussed on pages 17 to 20 of the April issue of *The Welding Engineer*.

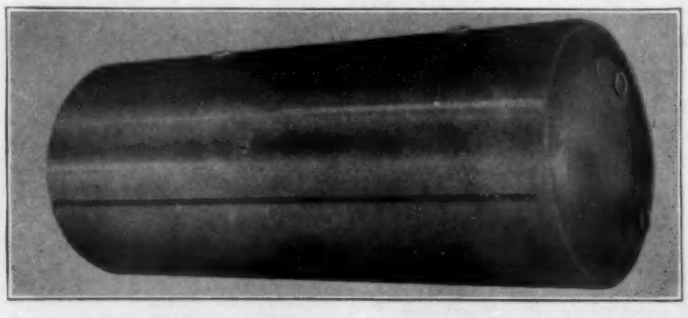
The development of a heavily-flux-coated electrode of the shielded-arc type has improved the arc-welding characteristics of these two metals. The miniature-electric-furnace effect resulting from the use of these thicker fluxes has resulted in welds of great ductility, strength, and soundness, and, incidentally, good penetration with no undercutting. The higher concentration of heat with the shielded-arc type of monel and nickel electrodes permits of somewhat higher speeds and, consequently, less buckling.

The diameter of the shielded-arc electrode should approximate the thickness of sheet being welded, up to about 3/16 in., and for plate heavier than that, either a 3/16- or ¼-in.-diameter electrode can be used. Generally, if the electrode is held in a position ahead of the arc—that is, the electrode is "pulling" rather than "pushing" the arc—and the rod is held at any angle between 45° and vertical, very satisfactory results will be obtained. A uniformly short arc, as short as can be maintained without quenching, is to be preferred.

Reversed polarity (work negative, electrode positive) will be found most satisfactory when using the No. 30 monel electrode and No. 31 nickel electrode, both of which are of the shielded-arc type. A very uniform arc condition is obtained, resulting, of course, in a smooth, uniform bead.

## Determining the Correct Machine Setting

The most convenient way of determining the best heat for a given job is to set the machine approximately and then proceed to weld. If the weld metal is not flowing out smoothly, the amperage should be raised, but if instead the weld metal is boiling, throwing off a shower of sparks and spattering generally, and the surface of the weld metal has a burnt appearance, then too much heat is being used. The welder simply must use his head to some extent with any welding operation. It is difficult to make any but very general recommendations regarding machine settings because the following conditions surrounding a welding set-up so seriously influence the setting of the machine: The machine itself; gauges of sheet being welded; whether welding single or multiple bead; whether joint is backed up with copper or being welded in the open; whether sheets are clamped to jigs or not; etc.; all of which are important.

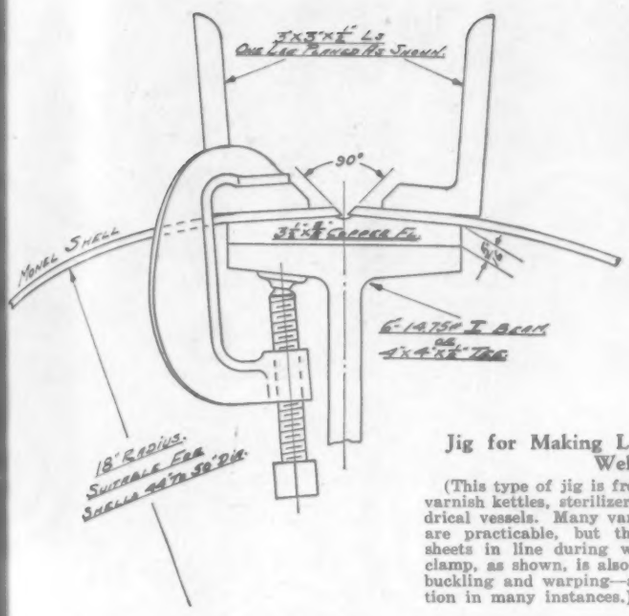


**Arc-Welded Monel-Metal Boiler, 150 Gallons Capacity.**

(The longitudinal seam is a butt joint, which was set up in a cylindrical boiler-welding jig, tacked every 8 to 10 in., then welded with a $\frac{1}{8}$-in.-diameter No. 30 monel electrode, at 75 to 80 amperes. This seam was held down against a copper backing bar having a very shallow groove directly under the seam. This groove served as a mold for molten metal and permitted of a uniform penetration. The flanged and dished heads were set inside the body cylinder and then electrically welded, with a $\frac{1}{8}$-in. electrode. The heads being of a heavier gauge of metal than the shell, this size of electrode allowed a good speed for a given cross-section of weld.)

## Setting Up and Welding Light-Gauge Sheets

Seldom is the upper gauge limit for metallic-arc welding of sheet metal asked about, but rather how thin a gauge can be welded by this method. Ordinarily, 0.062 to 0.050 in. (16 to 18 gauge U.S.S.) is considered the lower limit at which monel and nickel can be conveniently metallic-arc welded. However, much welding by both carbon and metallic-arc methods is being done in lighter gauges than this in both materials, but only through proper preparation of joint, judicious use of jigs, and experience. The use of a 1/16-in.-diameter electrode in monel with small welding machines, of course, permits welding of lighter gauges. For example, with a properly backed-up butt seam, held down tightly against the copper backing bar, it is possible to




**Jig for Making Longitudinal Seam Welds.**

(This type of jig is frequently used in making varnish kettles, sterilizer shells, and other cylindrical vessels. Many variations from the sketch are practicable, but the principle of holding sheets in line during welding is indicated. A clamp, as shown, is also useful in keeping down buckling and warping—an important consideration in many instances.)

metallic-arc weld 0.037-in. and 0.031-in. monel sheet, but this requires practice and a background of experience with these gauges.

Monel and nickel electric welds can be ground and polished on either or both sides, and these polished welds will be very clean and free of any porosity or slag inclusions. X-rays of metallic-arc welds on medium-gauge metal attest to the soundness of these welds.

A transverse bend test is commonly used as a quick means of determining the ductility of deposited metal; and when applied to monel, a complete 180° bend is obtained without sign of fracture, the pieces being hammered back-to-back. With nickel, slightly less ductility is obtained, a bend of approximately 160° being the average deformation obtainable without cracking.

Maintenance of a uniformly short arc is all-important in the use of the No. 30 monel and No. 31 nickel metallic-arc welding electrodes, if maximum penetration and protection of weld metal are to be obtained. A slight slow weave across the seam is desirable to insure a more uniform penetration. On gauges ordinarily welded with one or two beads, there is no necessity for preheating, but where castings are to be repair welded, it is desirable that these be warmed slightly before welding. After welding, the flux is easily removed by means of hand tools such as a chisel, handle end of file, etc. If any flux remains, it will not absorb moisture from the atmosphere, nor will it be corrosive to the parent metal.

### Procedure for Using the Carbon Arc

The carbon-arc method of welding is being applied to monel and nickel with no difficulty whatsoever. It is, of course, necessary that the carbon pencil be negative (straight polarity) and that a suitable, coated welding rod be used. The No. 20 carbon-arc welding rod is available for welding monel and the No. 21 carbon-arc welding rod for welding nickel.

With the carbon arc, welding proceeds in much the same manner as in oxy-acetylene welding, the carbon pencil being oscillated slowly across the seam and the coated filler rod dipped into the arc flame to melt off small drops of metal.

## Cutting on Inside of Caisson Results in Fatal Accident

Two operators engaged in a torch-cutting operation in a 38-in.-diameter caisson at the Wauwatosa pumping station in Wauwatosa, Wis., on April 20th, received burns that proved fatal. The caisson or well was 1,600 ft. deep, the men were working at a depth of 42 ft. below ground level, and the acetylene and oxygen tanks were hung in a saddle into the caisson, suspended above the place of operations, with 25-ft. lengths of hose between the torch and the tanks. Another oxygen tank of the 220-cu. ft. size was not lowered into the caisson, but was connected to an oxygen lance.

A fire started in the caisson while the two operators were working, the cause not being definitely determined. An alarm was immediately sounded, and the two men were hauled up, one after the other, to the top of the caisson and sent to a hospital in an ambulance. The two tanks likewise were brought to the surface.

About 15 or 20 minutes after the men were out, an explosion occurred in the caisson. An examination of the tanks showed that oxygen cylinders were empty, but all tanks were intact, except that the heat had allowed the fuse plug in the acetylene cylinder to let go. All equipment was said to be in good condition after the accident, with the sole exception that each hose had burned in two about 14 ft. from the cutting torch. Except at this point, the hose showed no burned condition either on the outside or inside, it is reported.

The report of the accident in some newspapers stated that the acetylene tank exploded, but investigation disproved that claim. The facts seem to be that the tanks were intact and were out of the caisson before the explosion occurred.

## Submarine Cables Spliced by Welding

Before starting the construction of the piers for the long bridge across San Francisco Bay between Oakland and San Francisco, it was found necessary to move twelve heavy telephone cables. Since these presented too much of a task to move under the water and were impracticable to raise partially out of the water and then move on barges, the engineers of the Pacific Telephone & Telegraph Co. devised a system of moving them a section at a time.

After a diver had located the cable on the surface below the bay, he sawed it through; and when each end had been covered with a rubber bag, it was pulled to the deck of a ship above. Hot petrolatum was poured over the exposed ends of the cable wires in order to dry the moisture out of the paper-insulated wires.

When the wires were thoroughly dried, they were spliced by the welding arc, as shown in the cover illustration of this issue, the armored covering replaced, and the boat shifted to drop the cable into its new location.

## Chicago Section Announces Program for May Meeting

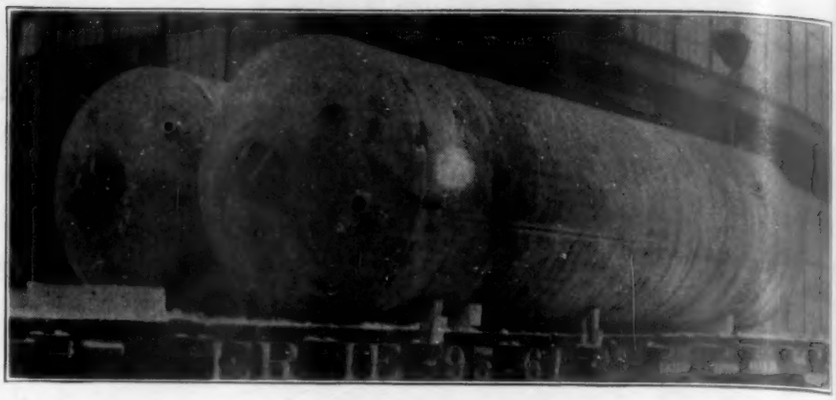
Talks on shop welding procedure and on warpage caused by welding, and a 3-reel motion picture on the making of steel, comprise the program of the Chicago Section of the American Welding Society, to be held at 7:30 p. m., May 24th, in the Sherman Hotel.

Harold Verson, chief engineer of The Allsteel Press Co., Inc., pioneers in the manufacture of welded steel presses, will talk on "Economical Welding Procedure in the Shop." A. L. Wilson, of the Mississippi Valley Structural Steel Co., will lead a discussion on "Warping Due to Welding."

The motion pictures on the making of steel are being loaned by the Illinois Steel Co., and show the details of all processes from the mining of the ore to the rolling of the final product.

The tellers will make a report on the recent election of officers. This is the Chicago Section's last meeting of the season.

The meeting will be preceded by a dinner at 6:15, in the Old Town Tap Room in the Sherman Hotel.



Pressure Vessels, 72 In. in Diameter and 23 Ft. Long, Made of Nickel-Clad Steel, With All Joints Welded, by The Babcock & Wilcox Co. Designed for 100-Lb. Working Pressure.

# Modern Materials for High-Pressure Vessels . . .

■ By L. P. McALLISTER
Assistant Metallurgical Engineer, Lukens Steel Co.

**ALLOY steels and clad steels are finding increasing use for the shells and heads of welded pressure vessels, points out Mr. McAllister in this paper, read before the annual meeting of the National Boiler & Pressure Vessel Inspectors, held in Chicago, on May 16th.**

IMAGINE admitting ten to fifteen years ago that boiler plate with tensile strength of 75,000 lb. per sq in. was fit for fabrication. Common opinion would have readily labeled such steel as *hard*, and yet today agreement is almost unanimous that the 55,000-minimum-tensile-strength steel, equal to specification S-1 of the American Society of Mechanical Engineers Boiler Code, is losing its popularity, particularly in heavy-walled shells.

## Introduction of Welding Creates Demand for More Uniform Steel

Designers have turned from butt-strapped joints to fusion-welded seams, and with welding came restrictions on material which the process of riveting did not demand. Fabricators realized, and welding experimenters discovered, that in large sections or heavy plates some lack of uniformity in chemical composition presented problems in obtaining ductile welds. Therefore, at the introduction of the metallic arc, the steel manufacturers found themselves confronted with a demand for more-uniform steel to permit acceptable welded joints.

Contemporary, naturally, with the demand for a more uniform base metal came extensive experimentation and development in welding technique and procedure. Next the carbon content in the boiler and firebox grades of steel was limited to 0.35% maximum. This restriction, although seemingly a natural one from the standpoint of the fabricating group, made it practically necessary that heavy plates be no longer produced of open or rimming steel, and required a killed or deoxidized steel by which process the carbon content could be maintained more uniform from end to end of large plates, thereby offering to the welder for his seams more homogenous and uniform edges.

Demands for higher pressures brought the necessity of thicker shells, and to meet or overcome some restrictions of fabrication the Boiler Code adopted two new higher-tensile steels — namely, Specification S-26 and Specification S-27, respectively, calling for 70,000 lb. per sq. in. minimum tensile strength for plate material up to and including 2 in., and over 2 in. up to and including 4 in. Here was a decided forward step, recognizing the advisability of higher-strength material balanced by good ductility and workability. Many tons of plates have been rolled, and to match these numerous heads have been flanged of this so-called high-tensile grade. Success to date has been rewarded by an increasing demand for this 70,000-lb.-minimum material.

The next step in developing plate material presents a new angle: the welding technicians advise against higher carbon, so to meet the still pressing requests for high strength, alloying elements have to be added to the plain carbon analyses. The properties of plain carbon steel, through long usage, have become fairly well known, as have its economic limitations. Now, with the advent of additional and sometimes singular properties inherited from contained alloy, boiler and pressure-vessel plate and head material presents a new economic aspect for consideration.

## Alloys Give Higher Strengths and Offer Metallurgical Advantages

When planning alloys for plate material, the first incentive is to produce higher strength without disproportionate loss of ductility. High strength in sufficient increments naturally permits a decided decrease in wall thickness and weight, and thereby presents for comparison a saving in purchased weight. The use of alloy steel may perhaps be more economically justified when due consideration is given to such factors as decreased purchased weight, reduced transportation costs on this lighter-weight material, both in the unfabricated and the fabricated state, possible lower shop costs due to the welding of thinner shell sections, and the metallurgical advantages derived from contained elements.

Prevailing fabricating methods and welding technique must be given due regard in new steels. Little, if any, advantage would result from superior quality alloys if fabrication and welding could not be carried out with success.

All designs today of Code construction, either American Society of Mechanical Engineers or American Petroleum Institute, are based on a safety factor of 5 or 4, and working stresses of ordinary steel are used as engineering data. Much work is to be done to prove that higher-strength, properly balanced alloy steels can present to the designer permissible stresses above those now set down for plain steel. A joint committee is at work, and shortly it is believed that new and higher-allowable-working-stress

tables will be adopted, thereby permitting advantage to be taken of the higher physical properties. To be fair and safe, a great many technical data must be collected and summarized in order that designing engineers, operators and inspecting groups may have confidence in the values.

## Better Properties Made Available by Using Alloying Elements

From judicially mixed or single alloys one should expect one or combinations of several of the following properties above those obtained in ordinary plate stock:

(a) High strength at elevated temperatures.
(b) High impact resistance at upper working temperatures.
(c) Definitely improved creep values.
(d) Good sub-zero impact ratings.
(e) Added resistance to some corrosive media.
(f) Better fatigue results.

To what elements now can the steel metallurgist turn for the providing of some of these improvements in large plate form?

The automotive engineers have had at their command for years many alloy combinations, and tube buyers likewise have had a fairly broad field from which to select. In view of the fact that the production and fabrication of small parts do not present the hazard that mass does, vessel and boiler material must come from alloy analyses which can be readily produced and constructed. Thermal effect on large and heavy sections has to be dealt with, and consequently today shell and head materials are available in alloy steels which are not so sensitive to the various stages of making and shaping, and thus the fear of hazardous workability must not be foremost.

Note should be made here that for welded construction, the Codes have listed among acceptable specifications only plain carbon steel for shell fabrication, and, however significant this fact may be, the day is not far distant when several alloy combinations must become essential parts of material specifications. High strengths are not at their maximum; as the welding art has changed its acceptable standard, so will limits of pressure, temperature and base material; and the next great step will undoubtedly be to base material having a minimum of 100,000 lb. per sq. in. tensile strength. The demands are present, the methods of production and fabrication are progressing and developing by experimentation, and slowly but safely is being gathered the knowledge needed for achieving this goal.

As stated previously, alloying elements for plate construction must not for sensible fabrication exhibit pronounced air-hardening characteristics. Intricate or even simple heat-treatments are not always advisable; quenching and tempering and long-time furnace annealing are always accompanied by out-of-flatness and warpage, making plate fabrication difficult, if not impossible. So, in existing developments, steels are being offered which have the improved qualities in the as-rolled condition. But by keeping this problem foremost, the full benefit of all the nonferrous elements cannot be had. Equipment to some extent limits the production of the more-special alloys requiring special treatments, but with the hoped-for industrial expansion it is to be expected that prog- will not be retarded.

Such common alloying elements as nickel, chromium, silicon, molybdenum and vanadium have been used with remarkable success. By use of small percentages, steel makers have been able to produce some of the qualities which should be expected from a higher-base-price material. One of the chief outstanding metallurgical advantages of the use of the elements mentioned is the maintaining of high strength by substituting one or more of these elements for increased percentages of carbon. Thus, with the so-called low-alloy-content steel, carbon need not exceed or even reach the limit of maximum 0.25%, as used in a 55,000 lb. per sq. in. tensile-strength steel, to produce tensile values over 50% higher than this figure. This advantage undoubtedly is attractive to the welding engineer.

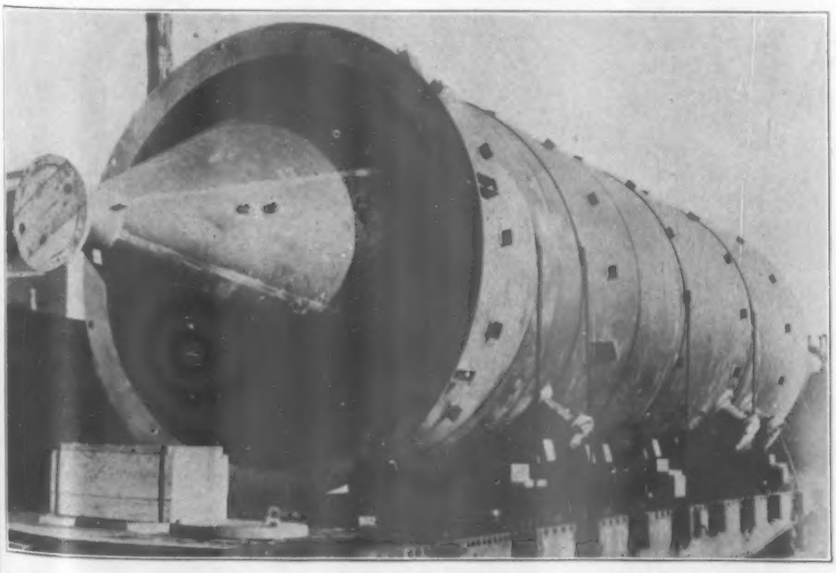
Unfortunately, there has existed in the minds of some users a suspicion or feeling of mystery about alloys. The metallurgical benefits from contained elements need only some understanding to alleviate such suspicion. Some regard for the properties imparted may slightly change fabrication methods, but not to such a degree that any ordinarily-well-equipped Class 1 welder need fear his ability to construct. Nickel, chromium, silicon, etc., are used to improve the steel—not to make it more mysterious. Stiffness of alloy material is to be expected; but so long as brittleness does not accompany the higher strength, the resulting toughness is an advantage. All tonnage to date has been preceded by experimental work, and it would not be amiss to discuss a few of the rather recently used alloy materials which have proved themselves worthy of the confidence intrusted to them.

## High Strength With High Impact Values at Low Temperatures

Two-percent-nickel steel with carbon under 0.20%, pioneered by a Canadian railway in a large locomotive-construction program, has served so well that many of the States' railroads have installed wrapper sheets of this analysis. The tensile strength of 75,000 lb. per sq. in. permitted a decrease in shell section, and although subject to the stress of locomotive service, the excellent ductility (see Table I) of this type has proved its merit. Even inside firebox sheets with an ultimate strength of 65,000 lb. per sq. in. have been installed, and longer life of side sheets with minimized crowfeet checking around staybolts has been noted.

This same analysis has found an opposite, although very important, use in sub-zero service. Here the added nickel definitely increases and makes uniform impact values even at temperatures as low as —100° F. Consistently, Charpy impacts of 15 ft.-lb. at —75° F. can be obtained (see Table II). So to the dewaxing process of the refining industry is offered by this alloy a metal whose resistance to shock at low working temperatures is far better than any plain carbon steel, as shown by results consistently obtained to date.

The United States Navy for its high



Welded Pressure Vessel, of Nickel Alloy Steel, for Sub-Zero Operation. Made by the A. O. Smith Corp.

tensile steel (80,000 lb. per sq. in. minimum tensile strength) found it advisable to list in its hull-steel specification a manganese-vanadium grade of the following typical analysis: carbon under 0.18%, manganese maximum 1.45%, and vanadium 0.08% to 0.18%. Numerous tests carried out at Washington designated to the Bureau of Construction and Repairs that this analysis exhibited less tendency to air-harden in the welded zone than some other steels so tested. Ship welding varies definitely from pressure-vessel welding in that stress-relieving or heat-treatment after welding is impossible. Consider now this analysis and its possibilities—a particularly high ratio between yield point and tensile strength (see Table III). If yield point were accepted as a basis of determining allowable working stress in Code design formulae, this steel would present a big advantage in weight saving.

## Molybdenum Improves Physical Properties at High Temperatures

Due attention is just beginning to center around carbon-molybdenum plate steel. By this is meant carbon under 0.25% and molybdenum between 0.40% and 0.60%. Tubes of this grade have been successfully used, and the plate industry is now arousing itself to the advantage that molybdenum gives—that is, definitely improved physical properties at elevated temperatures. One has only to scan the creep values of carbon-molybdenum steel and compare them with values of steels of equivalent room-temperature strength, and readily the imparted improvements can be noted. Advantage has been taken of this element in Europe for years. In plate and vessel material, a room-temperature strength of 75,000 lb. per sq. in. can be easily obtained. Units of this grade are in service in an Eastern refinery, and the latest information indicates complete realization of anticipated results.

## A. S. M. E. Code Committee Has Already Approved One Alloy

Mention was made previously that the American Society of Mechanical Engineers Boiler Code has not adopted any alloy grade for welded construction. However, one alloy specification—namely, S-28—has been approved for riveted construction. Such rapid and satisfactory progress has been made with this "C.M.S." steel that obviously early recognition for welded vessels is looked for. Such steel is made and listed in two grades, having tensile-strength values of 75,000 and 85,000 lb. per sq. in., respectively. The carbon content in the first grade is limited to 0.17% maximum, while the higher-strength grade permits a 0.25% maximum carbon. The name of this low-alloy steel—Cromansil—reveals its chief components—namely, chromium, manganese and silicon. Each of these elements is found in the following ranges: chromium, 0.30% to 0.60%; manganese, 1.05% to 1.40%, and silicon, 0.60% to 0.90%. The metallurgical balance of these three toughening elements has made possible a very versatile and workable low-alloy steel of good strength properties without the decided loss of that very necessary factor called ductility (see Table IV).

The merits of any material are best substantiated by its use, and actual tests are worth many expert opinions. The many tons of this steel which have been most successfully welded into Diesel-engine frames and housings of various intricate shapes and thicknesses, and the complete power units developing around 600 hp. at 1200 r.p.m., with the accompanying vibratory stresses, prove beyond a doubt that this alloy has weldability and toughness which warrant a great deal of consideration. By taking advantage alone of the high strength of the 85,000-lb.-minimum grade, reductions in weight are so evident that the steel's attractiveness cannot be denied.

Nickel-chrome-clad material has been produced whose corrosive-resistent properties present to users very definite economic savings. The strength of the plain-steel-base material can be used for computing working stress, and the thin layer of cladding, securely bonded, can be depended upon to resist the corrosion for which it is recommended.

## Class 1 Vessels Made of Nickel-Clad Steel

Plates with 10% and 20% cladding of nickel have been successfully produced and fabricated and fusion welded to Class 1 requirements of the American Society of Mechanical Engineers Unfired Pressure Vessel Code. Vessels so constructed meet, particularly in the chemical industries, a long-sought-for need. The manufacturing methods of this nickel-clad material have been so developed that uniform thickness of the cladding is assured, and the bond between the layer of nickel and the base steel is a metallurgical one. The good physical properties of the base metal are not impaired by this bonded layer of nickel, since this element alone is strong and ductile. Satisfactory welded joints can be made by using ordinary steel rods on the base-metal side, and pure nickel rods on the clad side, thereby making a continuous lining of pure nickel.

Other combinations of alloys worthy of consideration are being offered and developed for various purposes. The appreciation of improved quality is foremost today, and one of the very necessary aids for this development is the addition of wisely selected alloys. Due regard must be given, first of all, to well and carefully made steel, for just the addition of certain metals will not overcome poor melting practice. Extra care and close observation with technical control are most essential today in order to offer for fabrication and construction better and higher-quality steel. The selection of base material of the proper quality must be given thought, and the industry today more seriously than ever before is, so to speak, *use*-minded. Consequently, the opinions of fabricators and inspection groups are welcomed and encouraged in order to guide the development of either plain carbon or alloy-steel, since the day of special steels for almost all individual purposes is here to stay.

**Table I. Chemical and Physical Properties of 2.0%-Nickel Steel Plates.**

| ANALYSIS C | Mn | Si | Ni | Thickness in. | Yield Point lb./sq. in. | Tensile Strength lb./sq. in. | Elongation % in 8 in. |
|---|---|---|---|---|---|---|---|
| .13 | .52 | .20 | 2.10 | ¼ | 52,500 | 76,000 | 28.00 |
| .16 | .56 | .21 | 2.25 | ⅝ | 44,000 | 75,000 | 28.50 |
| .16 | .57 | .25 | 2.08 | ⅞ | 47,000 | 75,500 | 26.00 |
| .17 | .66 | .23 | 2.23 | 1 | 49,300 | 82,000 | 26.25 |
| .16 | .56 | .21 | 2.25 | 1 | 46,600 | 75,500 | 29.00 |
| .18 | .68 | .19 | 2.90 | 2 | 47,800 | 79,000 | 23.70 |

**Table II. Impact Values of 2.0%-Nickel Steel Plate.**

| ANALYSIS C | Mn | Si | Ni | Thickness in. | Charpy Impact Values, ft.-lb. —80 deg. F. | —75 deg. F. | Condition of steel tested |
|---|---|---|---|---|---|---|---|
| .16 | .62 | .18 | 2.22 | ¼ | 31-33-35 | 17-22-23 | As rolled |
| .15 | .49 | .19 | 2.03 | ⅝ | 31-29-34 | 19-21-22 | As rolled |
| .16 | .48 | .19 | 2.10 | ⅞ | 39-39-39 | 32-32-30 | As rolled |
| .18 | .54 | .19 | 2.10 | ⅞ | 35-38-36 | 20-24-30 | As rolled |
| .18 | .66 | .24 | 2.24 | 1⅛ | 32-35-35 | 18-22-20 | As rolled |

**Table III. Chemical and Physical Properties of Manganese-Vanadium Steel Plates.**

| ANALYSIS C | Mn | Si | V | Thickness in. | Yield Point lb./sq. in. | Tensile Strength lb./sq. in. | Elongation % in 8 in. |
|---|---|---|---|---|---|---|---|
| .15 | 1.40 | .20 | .13 | ¼ | 59,800 | 87,200 | 24.00 |
| .15 | 1.40 | .20 | .13 | ⅝ | 63,600 | 92,600 | 20.00 |
| .16 | 1.43 | .22 | .10 | ⅝ | 65,000 | 89,600 | 23.75 |
| .16 | 1.43 | .22 | .10 | ⅞ | 61,700 | 93,600 | 20.00 |
| .15 | 1.40 | .20 | .13 | ⅞ | 62,600 | 92,000 | 24.25 |
| .16 | 1.43 | .22 | .10 | ⅞ | 64,600 | 92,000 | 23.50 |

**Table IV. Chemical and Physical Properties of Cromansil Steel Plates.**

| ANALYSIS C | Mn | P | S | Si | Cr | Thickness in. | Yield Point lb./sq. in. | Tensile Strength lb./sq. in. | Elongation % in 8 in. |
|---|---|---|---|---|---|---|---|---|---|
| .12 | 1.12 | .030 | .017 | .55 | .54 | ¼ | 50,000 | 80,400 | 25.00 |
| .12 | 1.12 | .030 | .017 | .55 | .54 | ¾ | 47,100 | 76,300 | 27.00 |
| .14 | 1.26 | .035 | .022 | .77 | .47 | 1 | 55,600 | 80,200 | 26.50 |
| .21 | 1.17 | .014 | .024 | .72 | .47 | 2 | 53,200 | 85,600 | 20.00 |
| .14 | 1.24 | .010 | .018 | .76 | .47 | 3 | 45,600 | 77,400 | 21.25 |
| .20 | 1.28 | .027 | .018 | .73 | .52 | 1½ | 54,000 | 88,200 | 22.75 |

# Get "*H. O. T.*" on Welding

■ By H. O T. RIDLON

[This section is dedicated to Better Welding and Better Welding Shops. Suggestions and criticisms are invited.]

### We Speak Our Mind, Too

Thanks, Mr. Staley, for them kind words in your last issue of *Fusion Facts*. Some day I hope to climb into my little flivver and head West until I reach your office, for I honestly feel you gents of the Stoody Company can teach me a lot about hard-surfacing. You also publish a good magazine.

What's happened to "Acetylene Sparks" by H. A. G. in *Industry and Welding*? We have missed it, for we really enjoy sensible nonsense.

This is the beginning of my third year as conductor of this "line," and I wanted to start it with a grand story on welding that I have in mind. But, my friends, if you'll be patient, I'll assure you that one of these bright, sunny summer days you'll be getting it.

Congrats, Bob Kinkaid, on your new connection with *Steel*. I don't get to see every issue, because I'm pounding the highways and byways so fast and furious these days, but I'll be looking for it everywhere I go. Good luck to you, fellow, and may you be very happy with this new connection.

* * *

### Play, Frank!

Been hearing a lot of talk lately by some guy that they call Long that says if they elect him President that he'll make every man a King. Another gent that is a night-club master-of-ceremonies and a musician or something, says if you elect him President he will make every one a musician for some reason or other. Or he thinks that he has a reason. It may be so, and if those guys think that they can be elected, they are simply nerts.

It seems that all these mighty and powerful politicians own newspapers in which they can get their editors to tell any kind of a lie about themselves they want. Then some other sap thinks that maybe he can get the road paved in front of his house if he tells the same kind of a lie in his paper about this guy, and on it goes like a chain letter, and maybe some day you get a dime back, or feel sore because you bought the damn paper.

Well, I don't own any part of a newspaper, or ever hope to, so must depend upon our gentle editor to publish this foolishness.

But the other day in talking over all these things with one of my pals, he says, "Hell, Hot, if a kingfish or a musician think they can be elected President, why can't you be President? What's wrong with us having a welder President?" So I pops off and says, why not? So me pal says, "Here is our slogan, 'Get HOT for President!'" So he begs me to tell my public my platform, because he is sure that we will win. Why? you ask, and it is because "hot" is the best-known name in America, today. It's "Get hot on this" and "Get hot on that." It is hot dogs, hot coffee, hot soup, and hot this and that wherever you go. The doctors say take a hot bath in summer to get cool. In winter you take a hot bath and a hot drink to get over a cold. In fact HOT is in nearly every bathroom in this country. Take a look the next time you happen to go into one.

I do not choose to run on any of the present party tickets. They are all screwy to my way of thinking. I don't want anything to do with them.

I don't make promises to anyone, for I know I can't live up to any of them, just as any politician knows he can't when he makes them. But I'm going to be different, I'm not going to make any.

There is to be no campaign fund, so don't send me any money, or chain letters, for I've got a job, and have a strange habit these days of paying my own bills. I won't make any of you guys postmasters, for I'm agin any one being or trying to be what they are not. And I know durn well I don't want everyone in this country a welder, but I would not refuse to take that many orders for welding torches this year, if the cash was forthcoming with each order, but I know that won't happen. But I warn youse guys, look out for me when I do see you, for I sure as hell will forget "Get HOT for President" and try to get your order for welding equipment.

But I will try, if elected, to weld up the leaks in our government administration, and burn out the wastes. That's me; cut costs and show a profit, no matter what the job.

My slogan is: "America, and by that I mean, these grand and glorious United States of ours, *take off your coats and go back to work.*"

I'm for helping the guy who can't work, but I won't help the guy who won't work. Yes, my friends, I'm sick unto death of seeing guys turn down a job that will give them beans and a bed, and quit jobs that are giving them that or better. I'm fed-up feeding them, those guys who just won't work. I say send that kind to concentration camps, to work and farm or plant trees, or cut them down, until they find a job, or some of their friends or relatives find 'em work or are willing to dig down into their own jeans and support them. Those guys can make and grow enough so that Government and State institutions that are necessary expenses will be cut so low that it will be hardly an item to be considered in the administration expense.

I don't like to see fine old folks sent to homes for the aged. These loafers can build them comfortable little homes on government land and help them farm it and make it a self-supporting proposition. Make the old folks happy and contented, and a little independent, but these guys who quit jobs can do the heavy work for them.

Let everyone be what he wants to be, but don't hurt the other guy who wants to be something, has strength, courage, and ambition to always continue forward, up, and on the right path.

There are plenty of people, young and old in this great land of ours that have the right kind of intestinal fortitude. Let *all* of us help, not hinder their progress. For their progress is our progress, the progress of the United States.

There is only one thing I want; that is, that Will Rogers be Vice President with me, for I have read his smart sayings about those in the Senate and Congress. I know I can't depend on those boys for anything. I doubt if many of them ever read any of Will's wise-cracks, for if they did I feel sure that they would change their tactics. So I want Will sitting right there telling it to them, all the time. Maybe they can understand even if they don't or can't read.

Well, how's all this going to be done without a campaign fund and all the trimmings that the politicians ballahoo so much about? Easy, says I, for I'm sure that my brother salesmen and welders can sell me to the great American public without any trouble. I've seen you guys put over sales jobs when you had a lot less to sell; this ought to be like taking candy away from a child. I know the Hirstein Bros. can sell me to the farm vote. Carl Johnston, down Youngstown way, is going to sell me to the steel and iron industry.

So start your "Get HOT for President Club" now and we'll ride into office in the greatest landslide in history.

[*Without a campaign fund, you're licked before you start, HOT. Therefore, we are starting the ball rolling by donating five cancelled postage stamps and a dollar chain letter we haven't been able to sell. Other contributions from our readers will be tearfully accepted.—Ye Editor.*] * * *

The thought for the month: Much and great happiness is derived from helping anything, or anyone, grow.

* * *

A "Hot" Spark: It really takes a lot of horse-sense, to run a stable government.

## How We Built Up a Demand for Carbide Sludge

By LATIMER PARSON
P. E. Parson & Son Blacksmith Shop
Willmar, Minn.

Perhaps this little article will help the welder do a job that has always been considered an unpleasant one. When it comes to cleaning the generator, I have yet to meet the welder that enjoys this task.

Usually a 50-lb. generator uses a 100-lb. drum of carbide before it is cleaned, just because Mr. Welder dislikes the job of cleaning it. Perhaps, if we can find a market or use for this sludge that we so dislike, this gruesome task can be alleviated a bit.

Here in Central Minnesota it seems that a very ready market has been created for this sludge. If I say that you can cash in on this "white dope," it might sound ridiculous. But this has proved to be the case. If it is put up in from one- to five-gallon containers, it can be sold for at least 25c a gallon. Perhaps that forgotten generator will be emptied when it should be, if we can develop a market for the "dope." You will at least be paid for the time it takes to clean it out.

We have found many uses for it. In a recent clean-up campaign conducted on milkmen by our local health officer, we were able to dispose of 8,000 lb. It serves as a good insecticide in milk houses as well as chicken coops. It has enough of an offensive odor to send lice and insects in search of other quarters. Tell your farmer customers about it.

Next, we have used it at filling stations, on curb stones, pavement markers, drive-way stones and as flower-pot decorations. By adding a handful of barrel salt to each gallon, it seems to dry harder and stays on much better. It may sound impossible, but it has also been used to make stucco. Five years ago we stuccoed a bungalow with it by adding some Portland cement and sand, and to date it has proved to be very satisfactory. A man well acquainted with stucco work did the job and said that the stucco was very elastic and very easy to apply.

Two winters ago we constructed a 38x60-ft. blacksmith shop and used this same mixture, with results that were very satisfactory indeed. On this job we employed two men or brick layers that certainly knew their "mud," as they say, and they attested to the fact that they had never used its equal before. This building was put up in temperatures ranging from 20° above zero to 20° below zero, and the mortar joints are much harder than ordinary mortar joints. We also constructed a garage front about ten years ago that has proved equally gratifying.

From our experience with carbide sludge, we cannot say too much for its uses. Formerly we dumped all of it, but since having these experiences we find it too valuable to dump. We recommend it for any use where you ordinarily use slaked lime. Lime usually costs 70c per sack, and a 100-lb. drum of sludge will do for you what 70c worth of lime will do.

Now it's still easier to empty that generator!

Then comes the matter of basement white-washing, which has kept our supply down to where a person wonders what becomes of it.

Never a week goes by but we have three or four inquiries for this sludge. We cannot supply the demand made for it here. Our own welding shop has a generous application of this sludge, and it becomes a permanent job, too.

You could run a little "ad" in your local newspaper on carbide sludge, and we are sure you will be pleased with the results.

Be sure to keep the sludge covered with water when not using it, or it may dry and cake.

It has one more use, and if you don't believe it, just try it—it surely can clog your sewer pipes. We have a 6-ft.-deep settling tank that we empty the sludge into and pour off the water as the heavy material settles.

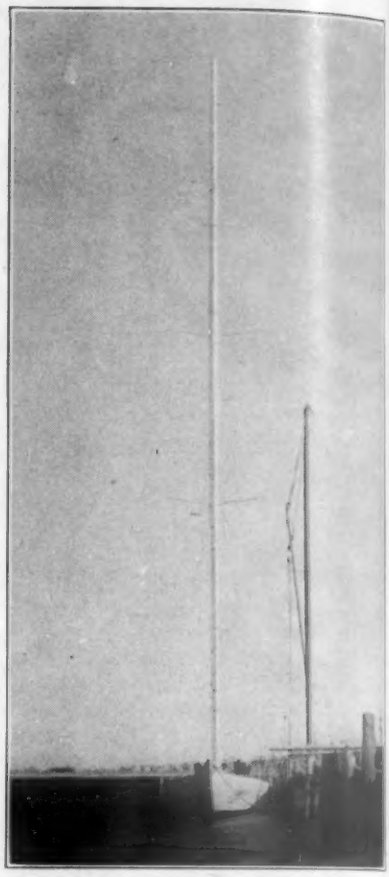
Some have used it for coating electrodes, claiming that it forms a good shield for the electric-arc rods.

Now, I hope that someone will find the generator-cleaning problem a little easier and a more pleasant task.

## Sloop With All-Welded Mast Passes Successful Test

The 126-ft. Boston sloop *Yankee*, scheduled to invade British racing waters this summer, thrilled many a yacht-racing enthusiast recently when she satisfactorily tested her new racing rig in a sail-stretching run off Neponset, Mass.

Rigging Fixture Welded to Mast.



The Arc-Welded Mast, Resembling a Silver Needle, Reaches 165½ Feet Aloft.

Skippered by her owner, Commodore Gerard Lambert of the Eastern Yacht Club, the *Yankee* bowled down Presidents' Road at 11 knots with a smother of foam along her weather rail and her 165-ft. welded steel mast appearing as a silver needle against the murky clouds.

The *Yankee's* steel mast, first of its kind ever turned out in America, was made by Geo. Lawley & Sons Co., Neponset, Mass., entirely of arc-welded nickel steel. In the face of a 12-knot southeast blow, this mast showed no sign of whipping.

The total length of the mast is 165 ft. 7 in., with a diameter of 18 in. at the bottom, tapering to 7 in. at the top. The thickness is 3/16 in. at the bottom and ⅛ in. at the top. The weight is approximately 5,700 lb., compared with 6,200 lb. for the former wooden mast which carried the *Yankee's* rigging in the 1934 America's cup trials. Besides saving 500 lb. in the weight of her mast, the *Yankee* also saves 320 sq. ft. of windage, which is equivalent to the sail area of a 30-sq. meter or 42-ft. racing sloop.

The mast, which is hollow, was built in four sections. Each section was made from a single sheet of steel, rolled to cylindrical shape with edges butted together and welded the entire length. When all four sections were completed they were welded together with a steel ring at the joint. All stays and other

rigging fixtures were then welded in proper position on the mast. The 450 ft. of welding required on the mast was done with a special electrode manufactured by The Lincoln Electric Co., Cleveland, Ohio. This electrode provides welds of 85,000 to 100,000 lb. per sq. in. tensile strength in high-tensile steels.

Stepping the *Yankee's* steel mast was a delicate job. It required over 50 men and a floating derrick. A 50-ft. timber lashed to the mast relieved the strain placed on it during handling. The derrick then picked up the mast and swung it into place. Finally, by use of capstan bars, it was twisted into its final position.

## Welders Hold Informal Educational Meetings

A group of welders on the south side of Chicago have instituted a plan of meeting at 7:30 p. m. on the first Tuesday of each month to hear talks by representatives of manufacturers of welding equipment and supplies. At the meeting on May 7th, which was held in the shop of Floyd Young at 741 W. 70th St., 15 were in attendance, and J. C. Menzies, of C. E. Phillips & Co., gave a talk on the welding of white metal and the making of machinable welds in gray cast iron.

## American Bureau of Welding Taken Over by A. W. S.

Owing to lack of funds to carry on the work of the American Bureau of Welding, the National Research Council has given up the sponsorship of the Bureau, in the promotion of which a number of engineering societies and other groups have cooperated. At the recent annual meeting of the American Welding Society, the Society voted to take over the American Bureau of Welding and supply funds for its continued activity, including the Fundamental Research Committee, which operates under the Bureau.

## 50 Tractors, Each With 56 Track Parts to Be Hard-Faced

The motto of G. V. Watson, proprietor of The Flour City Oxwelding Co., Minneapolis, Minn., is, "Go out and create work." While doing that very thing, Mr. Watson came across a contractor who had 50 "cat wagons," each having 56 track parts constituting the "cat wagon's" track. In operation each one of these 56 track parts will have the lip and tongue worn down. The contractor at first did not think favorably of the suggestion to weld them. Mr. Watson then offered to do one set of 56 pieces without cost to prove the possibilities, and his offer was accepted.

By building up with high-carbon steel and finishing with either managanese or Hascrome, a surface was obtained that under actual test wore better than new parts. Now Mr. Watson is doing 50 sets for this contractor.

# A Welding Engineer's Wife Speaks Her Mind

■ By ONE OF 'EM

### Attention A. T. & T.

At last I know what becomes of small boys who tinker. They grow up and get a job with the telephone company. Some of them do, anyway. The company sent one out the other day to repair our telephone, and I don't know when I've spent a more entertaining half-hour than I did listening to him. Chatting with the 'phone repairman might not seem like the absolute peak of gaiety if you are familiar only with the matter-of-fact gentlemen the company usually sends out. This one was a genius.

He told me first about his short-wave radio set, and how he rebuilds it so often that it is seldom in usable condition. Also, he explained that he had made a success of his marriage by spending so much time in the basement tinkering with his radio that on the rare occasions when he comes upstairs his wife is as thrilled to see him as if he were the Fuller Brush man or some other infrequent but exciting visitor.

Answering some questions of mine, he said that the "hams" take their sets apart constantly to rebuild them according to the theories hatched minute-before-last. And that the thing which drives radio experimenters on is the hope of making a lucky mistake that will solve some radio problem and reward the perpetrator. When I made some remark about the short-wave dialog seeming trivial and confined to questions such as "How am I coming in?" and "How is the weather?" he rebuked me. He said many friendships result from short-wave communication, and that it has an even more practical side. Seems that a Doctor Simpson of Los Angeles is a short-wave fan, and dispenses medical advice to his friends of the air when they signal him. "Whenever we get sickness in the house," my informant explained, "we call Doctor Simpson on the 20-meter band and ask him what to do." One hopes the good doctor has not abandoned his paying practice entirely to play around with DX bugs.

This telephone fellow had some smart ideas about a lot of things. I think the company has got a better man than it knows. He should not be fixing 'phones. He is writing a play, and knows what we should do about suicide, strikes, dust-storms and the flighty modern woman.

With his brains and social talents, he should be wearing a white shirt and sitting in a mahogany office handling kicks about the service.

• • •

### Butter-Fingers

Diners in a Cleveland restaurant looked out upon a surprising sight the other Saturday evening. A clumsy member of a Prospect Avenue track-welding gang dropped a lighted acetylene torch and it rolled under a gleaming new Dodge car parked at the curb. The car caught fire in no time and the restaurant manager and waiters tried to put out the blaze by squirting seltzer water upon the flaming chariot. Eventually the city fire department arrived but the car had been reduced to ashes by that time. How the owner felt is something to be conjectured.

• • •

### No Place Like Home—For Getting the Lowdown on Yourself

Children have many delightful uses in this world, and one is to keep their elders from acting foolish. Your friends will look upon your small weaknesses with charity, but your children will not. They puncture your little vanities without mercy, and ground you at once if they suspect you of thinking you are rather good.

All this is really being helpful, I suppose. Take my new hat, for example. I knew it was a pretty silly job when I bought it, but the salesgirl told me I looked exotic in it, and oo-la-la! Did I fall for that? Incidentally, is this a tricky new phrase the hat people have thought up to unload their gosh-awfuls? I have thought so ever since a friend of mine broke out recently in a Cossack turban that did her face no good at all. She has broken down since and owned up that she was duped by the same nonsense.

At any rate, home I went wearing my new Alpine bonnet, with the hotcha feather soaring from the peak. The family gasped and spluttered and said nothing at all at first. Sensing disapproval, I waited.

"The saleswoman said I was exotic and could wear it," I declared defensively as they kept on circling about me and eyeing my new headpiece.

"Exotic? Mother, for God's sake, send it back. You look like hell in it!" shrieked my candid offsprings.

So I did send it back, and got me another hat, a solemn turban sort-of-a-thing, better fitted to my years, I suppose. The thrill was all gone, but probably the children were right about it. They think in a straight line, that has learned no policy detours.

*What's New in*

# Equipment and Accessories

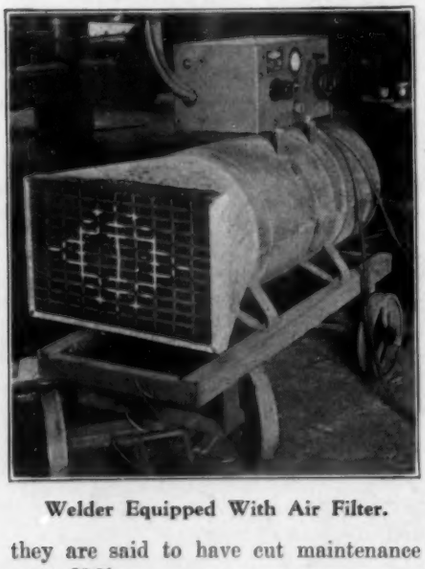
## New High-Strength Steel Is Readily Welded

Aptly named is Republic Double Strength Steel, a new high-tensile steel product of the Republic Steel Corp., Youngstown, Ohio. It is a copper-nickel-molybdenum ferrous alloy with yield point and tensile strength sufficiently higher than ordinary carbon steel to permit the use of 30% to 40% lighter sections without sacrifice of strength or safety factor. Good corrosion-resistance and forming qualities make it particularly well suited for the construction of railroad, truck and bus transportation equipment.

This new steel is made in two carbon ranges and is available in the usual commercial forms. It can be arc, gas or spot welded without loss of ductility at or adjacent to the weld. Cold-forming tests show high ductility.

## Air Filter Designed for Arc-Welding Machines

An air filter for arc-welding machines has been developed by the Niles Steel Tank Co., Niles, Mich., and is available in various models to fit all types of arc welders. This filter is said to remove approximately 90% of all foreign matter from the air before it passes the welder. In one plant where these filters are used,



**Welder Equipped With Air Filter.**

they are said to have cut maintenance costs 60%.

The filter pads are thrown away when the back side shows considerable dirt, the length of service depending upon plant conditions. Tank shops may safely use one filter pad about every 60 days, whereas foundries find it necessary to renew them about every three or four weeks.

## New Monel Casting of High Hardness

A new development in corrosion-resistant castings has been announced by the Bayonne Foundry of The International Nickel Co. This is the production of a new material of high yield point and hardness to meet special purposes. Known as S Monel, this material is somewhat similar in analysis to regular monel metal, the essential difference being in silicon content, which is raised to a maximum of 3.75%.

In properties, it has a higher hardness than the regular grade of monel metal and greater resistance to wear and erosion, particularly steam erosion. Of outstanding importance is the fact that it is non-galling, especially at high temperatures. The as-cast material can be machined without difficulty if the hardness is held to 325 Brinell by limiting the silicon to 3%. The harder grades must be softened for machining and later re-hardened by heat treatment.

A list of its unique physical properties shows an ultimate tensile strength of 100,000 to 120,000 lb. per sq. in., a yield point of 90,000 to 110,000 lb. per sq. in., an elongation of 2% to 5% in 2 in., a 2% to 5% reduction of area, and a hardness of 275 to 350 Brinell.

Another grade of monel metal, developed coincidentally, has an intermediate hardness of about 225 to 250 Brinell. Its chief advantage is a higher ductility than the S Monel, though it is not as outstanding in antigalling qualities. Its silicon content is approximately 2.50%.

## Fixture With Turntable Cuts Welding Time

A new type of welding fixture, with an inclined turntable arrangement for easier handling of circular pieces, has been perfected by the Harnischfeger Corp., 4513 W. National Ave., Milwaukee, Wis.

To enable the operator to weld continuously in a down-hand position, the turntable is equipped with an electrical rotating mechanism with gear shift and variable-speed motor control. The speed can be accurately regulated from 3 to 18 in. per minute in either direction at the circumference of the 42-in. table. Thus, for example, in welding a circular piece, the operator may hold the rod in a steady position as the work passes beneath it at the desired speed. The turntable can be tilted from one side of the base to the other or held in a horizontal position.

Recently, fabricating time on a huge gear was reduced from 32 to 13 hours when sixty-five 3/8-in. rods were deposited in two hours, by the use of this fixture.

Although primarily designed for handling circular shapes, it also handles

**Welding Continuously Down-Hand With Turntable Fixture.**

other unwieldy pieces. Known as the "RT," this new fixture is offered in various sizes to handle loads up to 4 tons.

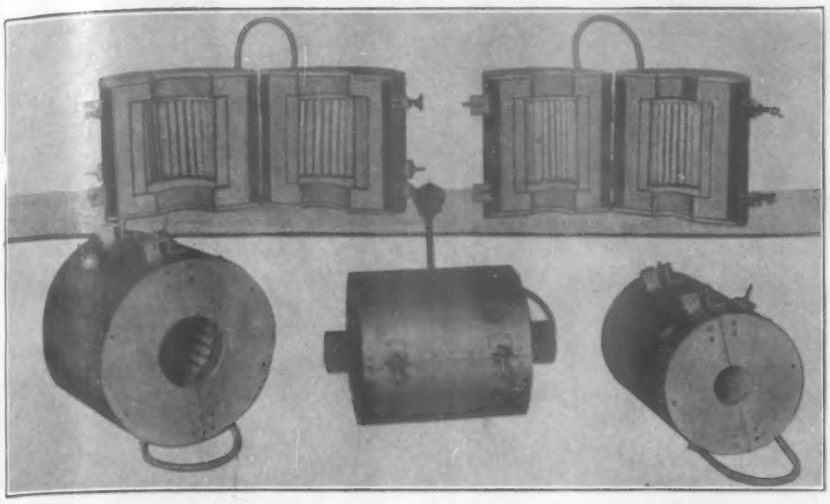
## Cutting Electrode for Manganese Steel

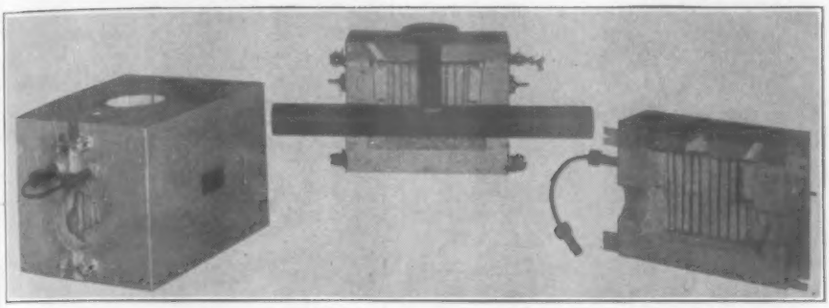
The manganese-steel-cutting rod for cutting out cracks in manganese-steel castings has been developed by the Stulz-Sickles Co., 91 N. J. Railroad Ave., Newark, N. J. While the cutting of manganese steel has not been generally recommended because of the possible overheating of the part, the manufacturers point out that in some cases cutting becomes advisable.

The new cutting rod is of regular manganese-steel composition, and therefore dissimilar metal is not deposited during the cutting operation. It has a heavy coating and is said to permit fast cutting.

## Fluxes for Stainless Steel and Silver Solder

New fluxes recently developed by the Anti-Borax Compound Co., Fort Wayne, Ind., include Stainless Steel Flux No. 9, and Silver Solder Flux No. 10. The No. 9 flux is said to dissolve oxides quickly and to provide a protective coating that prevents the formation of oxides; also it has no injurious effect on metals, it is claimed. The silver-solder flux is recommended for brazing with silver solder; it is said to flow quickly and does not bubble up. The company also announces an improved "Braz-Cast" Flux No. 4 for bronze welding cast iron.





Heaters for Local Stress-Relieving, Built in Two Sections for Clamping Around Pipe or Nozzle.

## Stress-Relieving Heaters for Piping and Nozzles

"Falcon" electric heaters of the cylindrical type for local stress-relieving of welded seams in high-pressure piping, etc., and also nozzle heaters for stress-relieving nozzle welds, have been announced by H. O. Swoboda, Inc., 4301 Main St., Pittsburgh, Pa.

The cylindrical-type heaters consist of two semi-circular heating units and include heat insulation, refractory plates, nickel-chromium heating elements and plug-type terminals with plugs for portable cable attachment. The refractories are backed by solid heat insulation around the sides, and similar insulation is provided on each end. The heater, together with its insulation, is assembled in a sheet-steel casing having high-temperature-insulating board ends.

Hinges are provided so the heater can be opened up for mounting around the pipe joints, and wing bolts keep the heater tightly clamped around the pipe. To facilitate reading the temperature of the pipe, a thermocouple opening is provided in the side of the heater.

One size of unit can be used for several pipe sizes. For example, a heater for stress-relieving 4-in.-diameter pipe can be used for stress-relieving smaller sizes of pipe by inserting bushings into the ends of the heater for each of the smaller sizes so that they will fit snugly around the pipe. In addition, the end heat insulation is removable, so the heaters can be used for stress-relieving the welds of pipe bends.

The heating area of the units is of such length as to insure that the weld, together with a certain specified distance on each side, is slowly raised to a temperature of 1200° F., which is attained within a specified time. As an illustration, a heater of 6½-kw. capacity is sufficient to raise the temperature of a 4-in. steel pipe of 0.337 in. maximum thickness up to 1200° F. in about 45 minutes, starting from cold (70° F.). When stress-relieving succeeding welds, after the heater has been thoroughly heat saturated, the time is reduced to approximately 20 minutes to secure 1200° F. Through the provision of proper control equipment, the pipe can be held as long as desired at the stress-relieving temperature and then allowed to cool.

The cylindrical-type units are supplied for stress-relieving pipes up to 8 in. in diameter. For larger pipes, the heaters are built in three or more segments for strapping around the pipe. For large pipes, penstocks, pressure vessels, etc., the units described on pages 32 and 33 of the April, 1934, issue of *The Welding Engineer*, are used.

The "Falcon" nozzle heaters consist of two sections, each arranged for clamping around the nozzle and pipe, except that for pipes over 6 in. in diameter, the heaters are furnished in four or more sections for strapping around the pipe and nozzle. Other details regarding the construction and use of these heaters are much the same as with the cylindrical type described above.

Both the cylindrical-type and nozzle heaters are wired for operating directly on various standard voltages, or they can be furnished for operation from welding-machine generators.

## Cutting the Cost of New Tools

The making of tools by depositing a metal giving tool-steel characteristics onto a low-alloy steel base is entirely feasible by the use of "Toolweld" as the coating, and the hard-surfaced tool gives the service of a similar tool made of high-grade tool steel, according to claims made by The Lincoln Electric Co., Cleveland, Ohio, distributors of "Toolweld," which is provided in rod form and applied by arc welding. "Toolweld" is also suitable for restoring the cutting edges of worn tools, as explained on page 38 in the February issue of *The Welding Engineer*.

The saving that can be made by using "Toolweld" in the manufacture of new tools is indicated by the experience of a manufacturer of automotive parts, who made the following calculations based on tool steel and on low-alloy steel hard-surfaced with "Toolweld":

| | Tool Steel | Low-Alloy Steel |
|---|---|---|
| Labor | $1.00 | $1.00 |
| Overhead | 2.00 | 2.00 |
| Material | 2.00 | .23 |
| Total | $5.00 | $3.23 |

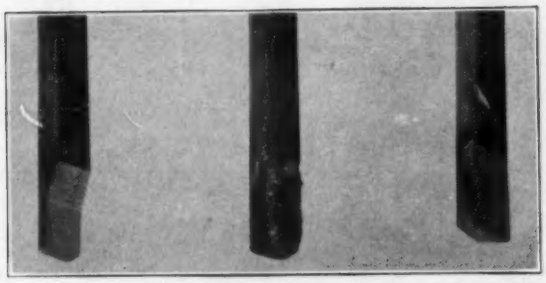
Percentage saving by using low-alloy steel, 35%.

These figures are based on a tool requiring 4 lb. of material, with tool steel

Angle Shear With Blades Faced With "Toolweld".

at 50 cents per lb. and low-alloy steel at 5¾ cents per lb.

This manufacturer annually has been spending $3,675 on reamers and cutters alone, these being made of tool steel.



**The Making of a Cutting Tool.**

(Left: Alloy-steel shank prepared for applying "Toolweld". Center: With hard-facing applied. Right: Tool ground to proper size and shape.)

With low-alloy steel, he calculated he would save 35% of the present cost, or $1,286 per year.

In making tools from alloy steel, a piece of steel is cut to proper thickness and length for the particular tool. The face and one edge of this piece are then ground down to a depth of approximately ¼ in. for a distance of about an inch from what is to be its cutting edge. The piece is then placed in a simple fixture and the deposit of "Toolweld" made on the face and edge which have been ground. Reversed polarity is used, with the proper value of current, which depends on the size of the electrode. The deposit is made with a weaving motion of the electrode, and will test between 55 and 65 Rockwell C. Each bead is cleaned thoroughly before the next one is applied, where more than one bead is deposited. The deposit is then ground to suit the particular requirements of the tool being made.

New and unusual applications of "Toolweld" are continually coming to light. It recently "saved the day" for a certain plant in the South who had received an order to furnish six ¼-in. tank plates, each to be punched or drilled with 80 2½-in. holes. The punching capacity being limited to holes of 1½ in. size as maximum, and with no drill of 2½-in. size available, the problem was to get those holes in the plate without having to spend about $35 for a drill of the required size, which might never be used again. Moreover, the job had to be delivered the next day.

But the plant had a 2¼-in. M.S. twist drill—a little undersize compared with the size of holes specified. Taking a "Toolweld" electrode, one of the welders put a layer on each side of the drill, halfway across and ¾ in. up each side and 3/16 in. high, which only required 4 minutes' time. The drill was then ground to 2½-in. size and put into the drill press. It worked to perfection, and the drill was sharpened only once during the 120 in. of drilling.

## Portable Electric Hammer and Grinder Combined

A new idea in the construction of portable electric tools is embodied in the new Wodack "Do-All" combination electric hammer and drill or grinder. The hammer mechanism, which is suitable for peening and other work, is so constructed that there are only two working parts, both of which are made of specially treated steels to give long life. The motor is of the universal type with forced-draft ventilation, and the tool may be operated from any light socket.

By simply opening the chuck and loosening a cap screw, the hammer member may be removed and the tool used as an electric drill, with a capacity of ⅜ in. in metal. It may also be used as a portable grinder and buffer. When used as a hammer with star drills, the tool drills holes in concrete and masonry up to 1⅜ in. in diameter, and by using special tools it does chipping, chiseling, cutting and vibrating. It is manufactured by the Wodack Electric Tool Corp., 4627 W. Huron St., Chicago, Ill.

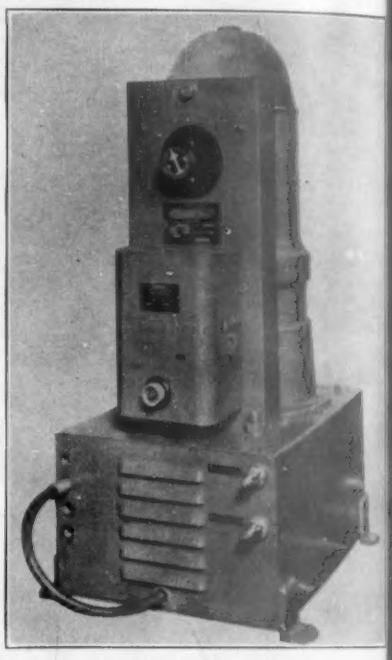
## Compact Welder Rated at 100 Amperes

A small, low-priced motor-generator type of arc-welding machine has been announced by The Lincoln Electric Co., Cleveland, Ohio. This machine brings the many advantages of arc-welding to automobile repair shops, sheet-metal and fabricating shops, and others called upon to weld thin-gauge materials.

Known as the SA-100, this new unit delivers as low as 30 amperes at the arc without the use of auxiliary devices, and has a current range up to 125 amperes.

The generator is of the variable-voltage type, with 100-ampere NEMA rating. A patented dual control provides independent adjustment of the open-circuit voltage and the welding current.

The generator is driven by a Lincoln "Linc-Weld" 5-hp. squirrel-cage motor, normally wired for 220 or 440 volts, but can be furnished for 110 or 550 volts, 3 or 2 phase, 60 and 50 cycles, as desired. Connections are readily available for re-



**New 100-Ampere Welder.**

connecting from 220 to 440 volts, or vice versa.

The SA-100 welder is 20 in. long, 16 in. wide and 40 in. high, and requires less than 2¼ sq. ft. of floor space.

# Trade Literature

"Equipment Designs for the Pickle House" is the title of an illustrated booklet issued by The International Nickel Co., Inc., 67 Wall St., New York, N. Y. Many monel-metal products are described, such as cradles, chains; bars, yokes and hooks for pickling wire; chain slings; crates and combs for pickling strip and sheets; baskets, racks, continuous pickling equipment, conveyors, drums, barrels, tanks, pails, pipes, etc. The engineering properties of monel metal are discussed, and methods of fabrication are described.

"Murex Electrodes" is the subject of an attractive, illustrated booklet issued by the Metal & Thermit Corp., 120 Broadway, New York, N. Y., which discusses the metallurgical advantages of these electrodes with their heavy mineral coatings, results of tests of Murex welds, electrodes for mild commercial steel, for the new high-strength steels, for 18-8 stainless steel, and for manganese-steel parts. Physical properties and chemical analyses of the deposits are given.

Textile equipment made of "Enduro" stainless steel is shown and described in a folder published by the Republic Steel Corp., Massillon, Ohio. Included is a series of actual-color illustrations of yarn samples dyed in acid and acid-chrome

# Confidence . . .

based on his ability and the welding rod he uses

MORE than a century of metallurgical experience accounts for the uniform composition and unvarying high quality of Anaconda Welding Rods.

Because they can depend on Anaconda Rods for uniformly good results, thousands of welders prefer them to other brands.

Fourteen standard Anaconda Welding Rods for gas or electric welding purposes are listed at the right. All are available through leading distributors. Usually shipped in bulk, but also obtainable in clearly labeled 10-lb. packages. Our new publication B-13, mailed on request.

MELTING POINTS OF ANACONDA WELDING RODS

| Material | Approximate Melting Point Degrees | |
|---|---|---|
| | Cent. | Fahr. |
| Tobin Bronze | 885 | 1625 |
| Manganese Bronze | 870 | 1598 |
| Brazing Metal | 930 | 1706 |
| Economy Bronze | 885 | 1625 |
| Everdur | 1019 | 1866 |
| Anaconda 520 | 885 | 1625 |
| Phosphor Bronze A | 1050 | 1922 |
| Phosphor Bronze E | 1070 | 1958 |
| Phosphor Bronze D | 1000 | 1830 |
| Phosphor Bronze C | 1025 | 1877 |
| Silicon Copper | 1083 | 1981 |
| Deoxidised Copper | 1083 | 1981 |
| Electrolytic Copper | 1083 | 1981 |
| Nickel Silver | 1055 | 1931 |
| Ambrac | 1150 | 2102 |

ANACONDA

THE AMERICAN BRASS COMPANY

*General Offices:* Waterbury, Connecticut

*Offices and Agencies in Principal Cities*

In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

# ANACONDA WELDING RODS

colors, showing how Enduro stainless steel holds the true color of the dye without the slightest change. In writing for the folder, refer to it as Form 146.

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A chart giving the sizes of rectangular and circular plates made by shearing or flame cutting in the plant of the Lukens Steel Co., Coatesville, Pa., is available from the company. Plate thicknesses are listed up to 25 in., and attention is called to the fact that the larger sizes listed are rolled on the company's 206-in. plate-rolling mill.

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The Coen Metal Atomizer, for the spraying of atomized metals, is illustrated and described in a folder issued by the Coen Co., 915 Bryant St., San Francisco, Calif. The process and the tool are described, and applications are listed.

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Crane-track wheels of the double-wall type, made of manganese steel, are illustrated and described, and dimensions are given, in a leaflet issued by the American Manganese Steel Co., 382 East 14th St., Chicago Heights, Ill.

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Tension-control motor bases, for short-center drives, are described and prices and dimensions given in a folder being distributed by the Machinery & Welder Corp., 312 N. Sheldon St., Chicago, Ill.

# Commercial News

## A. M. Candy Joins Staff of Hollup Corporation

A. M. Candy, internationally known welding engineer, has joined the engineering staff of the Hollup Corp., with headquarters in Chicago.

Mr. Candy was formerly general welding engineer for the Westinghouse Electric & Manufacturing Co., at East Pittsburgh, Pa. He has been engaged in the welding business for almost 20 years, and has presented numerous lectures and

A. M. CANDY

written many papers on welding. He is one of the pioneers in advocating the use of welding in building and bridge construction, and has been active for years in encouraging the use of welding by the railroads, also he has taken out many patents on welding apparatus.

He has been an active member of the American Welding Society from the beginning of its organization, and has served as a director and in other capacities. He is also active in the American Institute of Electrical Engineers, and is a member of the Sub-Committee on Welding of the Boiler Code Committee of the American Society of Mechanical Engineers.

Mr. Candy will be actively engaged in engineering and sales work with the Hollup Corp., who recently acquired an exclusive contract to distribute Westinghouse welders to all railroads in the United States and Canada.

## Smith Spikes Rumors That They Are to Quit

"Welding equipment is now and always has been the major part of our business and will continue to be indefinitely," said E. C. Caluwaert, of the Smith Welding Equipment Corp., Minneapolis, Minn., in reply to a query following up the rumor that the company was to discontinue the welding-equipment business and confine itself to the manufacture of beer pumps.

The division of the company which manufactures and markets beer pumps has no connection whatsoever with the welding-equipment division, other than it operates under the same name.

"We are pleased to report that at no time in the history of our company has our welding-equipment business been better than it is at present, and 1934 was one of the most satisfactory years we have ever experienced," Mr. Caluwaert added.

## Harris Calorific Company to Build New Plant

The Harris Calorific Co., of Cleveland, Ohio, have been at their present location, facing Bulkley Blvd., for the past eighteen years. For the last year and a half expansion plans on its adjoining property were under consideration. This building program was delayed, owing to the fact that rumors prevailed to the effect that the United States Government, through the FEA, were contemplating taking over the site upon which the Harris Calorific Co. was located, as a Low Cost Housing Project. The government finally decided to go ahead, and recently acquired the property of the Harris Calorific Co., as well as the adjoining property, for what is known as Cleveland's Low Cost Housing Project No. 3.

As matters now stand, the Harris Calorific Co. are planning on building a new fire-proof building of approximately twice their present capacity to cope with an increased demand for their apparatus. Preparations are now under way whereby there will be no interruption of service to distributors and customers during the moving of the plant.

## Holds Welding Clinic in Detroit

A welding clinic held by the Weldit Acetylene Co. at their plant in Detroit, Mich., on May 13th, was attended by 4[illegible] supervisors and executives of various metal-working plants in the Detroit territory.

A very interesting talk on the application of self-hardening rod was given by C. E. Phillips, of C. E. Phillips & Co.

Demonstrations with shielded-arc electrodes and non-ferrous brazing rods were made by Mr. Sloan, electrical engineer of the Weldit Acetylene Co., and Mr. Manor, sales manager of the same company.

The company served refreshments. Because of the high interest shown, it was decided to hold another such meeting at an early date.

## Sight-Feed Offers Training to Distributors' Salesmen

As an aid in building up a strong distributor organization, the Sight-Feed Generator Co., of Richmond, Ind., invites each new distributor to take advantage of the company's facilities offered by their welding school. The distributor is asked to send one or more men from his organization to the school for an intensive course in welding and cutting procedure.

Not only does this course of study cover every angle of safety and technical operations, but a portion of the lecture course is devoted to metallurgy. The student has the opportunity to use various types of welding equipment now on the market and to become acquainted with the service requirements of various lines. Naturally an intensive program is built around the operation and use of the company's own equipment.

After the student completes his course of study and returns to his territory, he receives over a period of 40 weeks a series of lessons in question-and-answer for[illegible]

# Proven Superior

## ...and Here are the Reasons

ACCOMPLISHED RESULTS have proven the superiority of DUROX-S for resisting shock and abrasion—not only in competition with untreated steel, but against other competitive alloys.

DUROX-S differs fundamentally from other metals, in that it sinks into the base metal by its own weight to become an integral part of the treated piece.

DUROX-S is furnished in either rod or bulk form or as an electrode. Any experienced welder can apply it—in the shop or on the job—utilizing either arc or acetylene.

DISTRIBUTORS, responsible and aggressive, are being selected for a few remaining areas. Communicate direct with factory for full information.

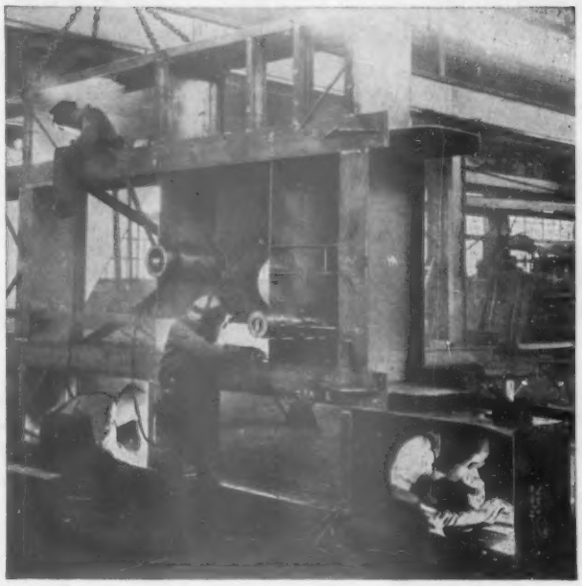
*Write for our Literature*

**ENTERPRISE FOUNDRY CORPORATION**

*Founders—Metallurgists*

902 19th St. San Francisco

ARC-WELDERS
**ADAMS**
ELECTRODES



● This swing frame for 40,000 lb. capacity crane could not be normalized but had to be built to withstand heavy shock stresses. Orton Crane & Shovel Company, the manufacturers, solved the problem by using Adams Anneal-Craft Electrodes, which produce an annealing action that reduces locked-up stresses.

Let Adams arc-welding equipment and electrodes improve your product. The Adams line includes:

Motor-Driven Arc Welders, Vertical Type

Gasoline-Driven Arc Welders

Gas and Slag Shielded Electrodes

Processed and Bare Wire

Adams-Una Automatic Welding Heads

Automatic Welding Wire

Accessories

**J. D. ADAMS COMPANY**
INDIANAPOLIS, INDIANA
*Offices in Principal Cities*

TOOLS FOR PRODUCING BETTER FUSION METAL

which not only reviews his activity in the school but covers in detail the subject of welding and cutting.

The Sight-Feed Generator Co. are not pioneers in this type of promotion, but they have introduced a number of original ideas which they claim are proving to be extremely valuable in tieing up the sales activity of the distributor and the manufacturer to a unified program.

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Several new distributors of "Regorods" and "Rego" welding and cutting equipment, made by The Bastian-Blessing Co., Chicago, Ill., have been announced. Among these are the Mansfield Cylinder Gas Co., Mansfield, Ohio, and the Welker Chemical Co., Cleveland, Ohio, both working under Gas Products, Inc., of Cleveland, as distributors. Also the Craig Motor Parts Co., Uniontown, Pa.; Jackson & Grow Machine Co., Morgantown, W. Va.; and Patterson Auto Parts, Butler, Pa., have been added, all operating in the territory supplied by the Welderaft Equipment Co., of Pittsburgh, Pa.

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The Universal Welding School, for the teaching of arc welding, has opened at 1032 South 41st St., Milwaukee, Wis., with George S. Brenchley as instructor. The school offers a 160-hour course, running eight hours per day, five days per week, and is four weeks in length. Several different makes of both d. c. and a. c. welders are being used, it is claimed. Mr. Brenchley reports that a 20x40-ft. addition is being made to their present building, this to be completely welded with a pipe framework, with corrugated iron sheets for sides and top.

---

A welding booth for instructing welding operators, and a polariscope for investigating strains, are available in the new quarters of T. A. Canty, at 1023 Cathedral St., Baltimore, Md. Because of a substantial increase in business, this concern found it necessary to seek larger quarters in the new location, their former address having been 116 E. Centre St. Mr. Canty is distributor of welding equipment and supplies manufactured by The Lincoln Electric Co., a stock of which he maintains on hand.

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Ralph A. Terrell recently joined the Ingersoll Steel & Disc Co. at their West Pullman (Chicago) plant as chief engineer, succeeding S. S. Battles, who recently resigned to become president of the Midwest Stamping Co., Morrison, Ill. Mr. Terrell, a graduate of Cincinnati University, was formerly superintendent and chief engineer of the South Bend Tool & Die Co., South Bend, Ind., and previous to that he was efficiency engineer for the Frigidaire Corp., Dayton, Ohio.

The Metal Spraying Corp., Milwaukee, Wis., have moved their shop equipment from 3132 W. Garfield St. to 3610 W. Pierce St. The new location, which consists of 5000 sq. ft. of space, compared with 1500 sq. ft. in the old location, has sufficient space for trucks to drive in, and includes a railroad siding and a loading dock. A laboratory is being added for testing and research in connection with the company's metal-spraying work.

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In order better to serve the interests of the steam-railroad industry, a combination has been effected between the arc-welding manufacturing and technical facilities of Westinghouse and the Hollup Corp. sales service, whereby the Hollup Corp., 3357 West 47th Place, Chicago, Ill., becomes exclusive distributors of Westinghouse welding equipment, with distribution points in 18 U. S. cities and two Canadian cities.

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In order better to serve their students, and to broaden their courses, the Cleveland School of Welding, Inc., Cleveland, Ohio, are adding a new arc welder, an atomic-hydrogen welding unit, a generator for producing Ferrolene gas for welding and cutting, two oxy-hydrogen welding units for aluminum, two acetylene generators, and one automatic shape-cutting machine.

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The Champion Rivet Co., of Cleveland, Ohio, announce the appointment of Thomas J. Kegg as their direct factory representative on welding electrodes in the Southwest, with headquarters at Sawyer and Winter Sts., Houston, Texas. Mr. Kegg has been assistant sales manager of The Champion Rivet Co., in charge of welding-electrode sales, for the past four years.

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The Philadelphia sales office of the Republic Steel Corp. and its subsidiaries, the Berger Manufacturing Co. and the Union Drawn Steel Co., has been removed to the Broad St. Station Building, 1617 Pennsylvania Blvd., the former address having been the Fidelity-Philadelphia Trust Building. J. B. DeWolf continues in charge of the office as district sales manager.

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Due to the large amount of welding being done and a still larger amount later on, the "Peoria School of Welding" has been opened at 806 N. Main St., Peoria, Ill. Classes are held on Monday, Wednesday and Friday nights of each week. The course is priced at $50 and includes 27 hours of actual welding. The instructors include "Red" Groves and Faye Cole.

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A National Trade Fair will be held in the Hotel Sherman, Chicago, Ill., June 24th to 28th, under the auspices of the National Inventors Congress, according to Albert G. Burns, president of the Congress. The morning meetings, beginning each day at 10 o'clock, are open free to the public. The exhibit of new inventions will hold forth from 2 to 10 p. m. each day.

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Application of the electric arc to the welding of manganese steel in the building up of manganese railroad frogs and crossings, crushers, dipper teeth and other manganese parts, is covered in patent No. 1994479, pertaining to a method of manganese-steel welding, it is pointed out by the Morrison Railway Supply Corp., Buffalo, N. Y.

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A 3-day clinic was conducted on April 30th and May 1st and 2nd by V. Stambaugh Thompson, at Youngstown, Ohio, at which "Rego" welding and cutting equipment, Alemite lubricating systems and De Vilbiss paint-spraying equipment were featured. A large and interested group attended the 3-days' program.

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The Hercules Motor Corp. announces the removal of their West Coast representative's office from 613 Russ Building, San Francisco, Calif., to Room 523 Transportation Building, 7th and Olive Sts., Los Angeles, Calif. Oliver Kelly is the direct factory representative in charge.

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The Machinery & Welder Corp., Chicago, Ill., announces the opening of a branch office at 1705 Baltimore Ave., Kansas City, Mo., in charge of Albert W. Roth, district manager. A complete line of gas- and electric-welding equipment will be carried in stock.

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Lee Wright has been appointed sales representative for the Republic Steel Corp., with headquarters at 401 Atlas Building, Salt Lake City, Utah. Since 1902 Mr. Wright has been associated with Zion's Cooperative Mercantile Institution in Salt Lake City.

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The summer meeting of the Compressed Gas Manufacturers Association will be held at the Seaview Golf Club, Absecon, N. J., on June 13th to 15th, the opening event being a dinner at 7 p. m. Thursday, June 13th.

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G. F. Meyer, formerly in the Chicago office of the Machinery & Welder Corp., has been appointed Milwaukee representative for the same company.

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The Lukens Steel Co., Coatesville, Pa., have moved their New York offices to Suite 2714-15 in the Chrysler Building, 405 Lexington Ave.

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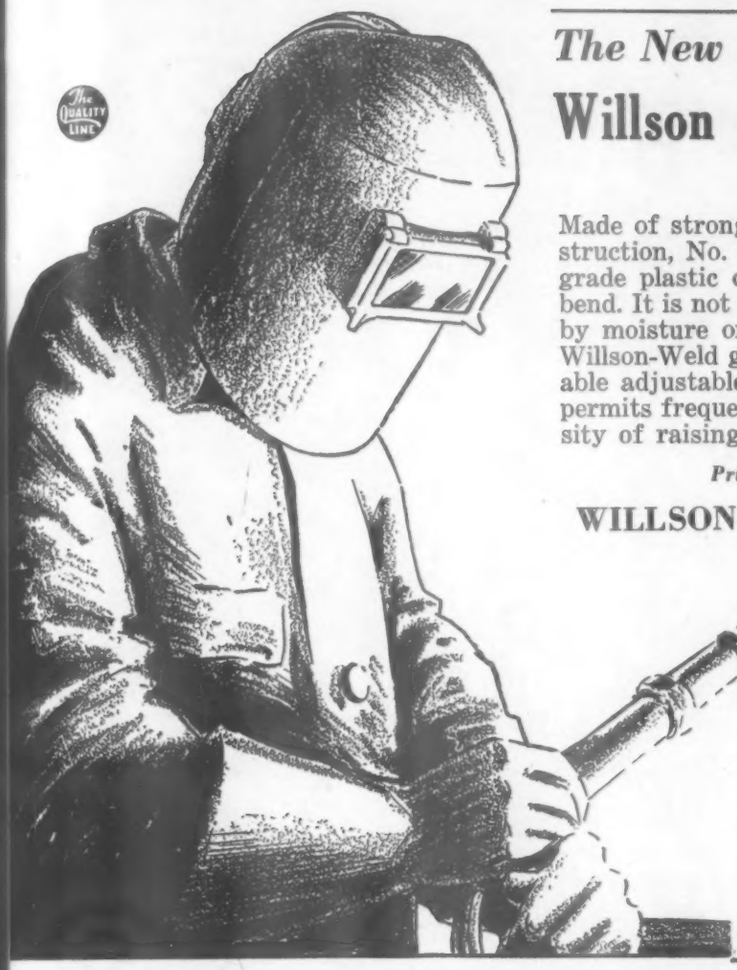

*The New*

# Willson Composition Flip Front

**Welding Helmet No. 20**

Made of strong vulcanized black fibre, with riveted construction, No. 20 has a flip front glass holder of a good grade plastic composition which will not warp, dent or bend. It is not a conductor of electricity and is unaffected by moisture or extreme temperatures. It is fitted with Willson-Weld glass, easily replaceable and has a comfortable adjustable, three position headgear. The flip front permits frequent, quick job inspection without the necessity of raising the helmet.

***Price: $9.90 each f.o.b. shipping point***

**WILLSON PRODUCTS, Inc., Reading, Pa.**

Patent Applied for

# $125.00 *in Cash Prizes*

## To Job Welding and Blacksmith Shops

***For reports on Farm Equipment hard-surfaced with Stoody Products in their shop, which have shown the best service records.***

**SIX CASH PRIZES: 1st, $50.00; 2nd, $25; 3rd, $20; 4th, $15; 5th, $10; 6th, $5.**

A plowshare hard-faced with Stoodite.

***It's easy to enter this contest—but you must hurry. . . . . .***

***IF***

**you are interested in machinable Cast Iron Welds made by the Metallic Arc process send for bulletin entitled "Electrodes for Making Machinable Cast Iron Welds."**

**This bulletin describes Nico, Copper Arc and Arcast electrodes, the three electrodes that meet practically all requirements encountered in the welding of cast iron in the foundry, machine shop or repair work.**

**WRITE TODAY.**

The service records submitted for this contest must have been made between January 1, 1935 and June 1, 1935. Record with application blank completely filled out, must be mailed to C. E. Phillips & Co., showing postmark dated not later than June 15, 1935.

You may submit as many records as you wish—each on its separate application blank, but not more than one prize will be awarded to any single individual or shop.

## C. E. PHILLIPS & CO.

5443 Twelfth St., DETROIT, MICH.

324 S. Jefferson St., CHICAGO, ILL.

**MAIL THIS COUPON**

**Please send the following free literature:**

1—Application blank to enter prize contest.

2—New bulletin, "Application of Stoody Products to Agricultural Implements," which gives accurate information on hard-facing farm machinery and implements.

3—Leaflets—"Plow shares can make money" for distribution to your customers. Name quantity desired.

Name..... Address.....

# Notes From the Field

The large dredge boat *American* docked in Peoria April 18th to straighten two rear studs, which had been twisted and broken in turning the boat. The crew was unable to use their own welding equipment and called on the Superior Welding Co., 331 Knoxville Ave., Peoria, to do the work for them. Two welding machines were used and four welders worked at top speed to enable the boat to continue on its journey with the least possible delay. One hundred and sixty-five pounds of rod were used in a gruelling 26-hour stretch of welding.

Johnny's Welding Shop, 1115 Russell Blvd., St. Louis, Mo., fender-welding specialists, have confined themselves to the repair of pleasure cars for the past four years. According to A. Johnson, proprietor, this plan has proved very successful, eliminating all heavy and difficult work and enabling the company to conduct a strictly cash-and-carry business. Business showed a 20% increase from January 1st to April 1st.

The Twin Cities Service Co., 1609 Lafayette Ave., St. Louis, Mo., formerly in the auto-painting business, plan to go after the welding and brazing trade, maintaining painting and dent work as a side line. New, modern equipment was recently added to the shop, and business has been increasing at the rate of 5% monthly, the company reports.

The Standard Carriage Co., of Los Angeles, Calif., recently completed the construction of five all-welded passenger trailer-type coaches for use in transporting sightseers about the exposition grounds during the World's Fair in San Diego, which exposition opens May 29th of this year.

The Eastman Oil Tool Co., of Long Beach, Calif., is erecting a new plant at 2901 American Ave., and will move into the new building in the near future from the old location at 2895 American Ave.

K. R. Elsworth, who operates a blacksmith shop and garage at Wheeler, Mich., has added a welding department to his business.

# · CLASSIFIED ADS ·

**Help Wanted—75c per line, minimum 4 lines. Jobs Wanted—4 lines free. Other Ads—$1.00 per line, minimum 4 lines. Count 8 words to line. Add 6 words for keyed address.**

## FOR SALE

**For Sale**—Seven 200-ampere, 220/400 volt, 60 cycle transformer welders, $150 each. Also 200- and 300-ampere Lincoln and G-E welders, electric-motor and gasoline-engine drive. Goodman Electric Machinery Co., 1060 Broad St., Newark, N. J.

**Guaranteed Welders**—Two 300-ampere Type FKW Lincoln gasoline-driven arc welders. Priced at $500 each, which is less than cost to assemble. Completely guaranteed. Other types in stock. Service Co., 3732 Cedar Ave., Cleveland, Ohio.

**Bargains**—Demonstrator Arc Welders. Gasoline and electric drive. 30 days' trial. Easy terms if desired. Write Ken's Exchange, Box U-551, Troy, Ohio.

**Gas-Burning Preheaters**—Will do your work from smallest to largest job. Free trial to responsible firms. C. M. Hale, Wilmington, Ohio.

## HELP WANTED

**Sales Engineer Wanted**—Capable of selling and demonstrating acetylene, metallic-arc and automatic arc-welding wire. Give age, experience, references and salary expected. Address May-2, The Welding Engineer.

## POSITIONS WANTED

**Welder Foreman**—Experienced on all classes of shielded-arc electrodes and with ferrous and non-ferrous metals. Can run a shop or a crew of men. Twenty years' experience. Married. Will go anywhere, either U. S. or foreign. Can read blueprints, do some mechanical drawing, and give estimates. Best of references. Address Box May-3, The Welding Engineer.

**Bookkeeper**—Young lady, 22, University graduate, at present employed in machine shop and foundry using welding, wishes full-time position. Experienced in bookkeeping, credit collections and secretarial work. References. Address May-1, The Welding Engineer.

**Combination Welder**—2 years' practical training and instruction, gas and electric welding, lathe. Age, 22. Address May-4, The Welding Engineer.

PRACTICAL WELDING
WELDING ENGINEERING
For 32 years we have specialized in engineering training and now offer comprehensive PRACTICAL and THEORETICAL ARC WELDING courses under actual working conditions. Nationally known engineers and technicians train you personally.
Write for illustrated bulletin without obligation.
MILWAUKEE SCHOOL of ENGINEERING
Institute of Electrotechnics
1020-34 N. BROADWAY

MAKE STRONGER WELDS FASTER IN
No Puddling **WHITE METAL** No Flux
White Metal is easily and quickly welded with Aladdin Rod at a profit. Don't continue to lose profit by turning down White Metal parts. Only Aladdin Rod is guaranteed to produce welds of greater tensile strength than original metal. Unexcelled as an aluminum solder. Directions with each pound. If your jobber cannot supply you, order direct.
Assorted, 1/16 and 1/8 in., $2.50 per lb. 1/8 in. rod, $2.75 per lb.
THE ALADDIN ROD & FLUX MFG. CO., 947 Fifth Ave., Des Moines, Iowa

**EVER-KLEAR COVER LENS**
Insure maximum safety at minimum cost. Shielded coating eliminates pitting and distressed eyes. Perform equally as well in goggles as in arc welding shields. Guaranteed 200 welding hours.
Size 2x4 1/4" @ $2.40 per dozen.
Size 45 to 50 M.M., inclusive @ 35c per pair.
*Dealers in Principal Cities*
F. R. FAULK 50 Penn Ave., Pittsburgh, Pa.
DISTRIBUTOR